

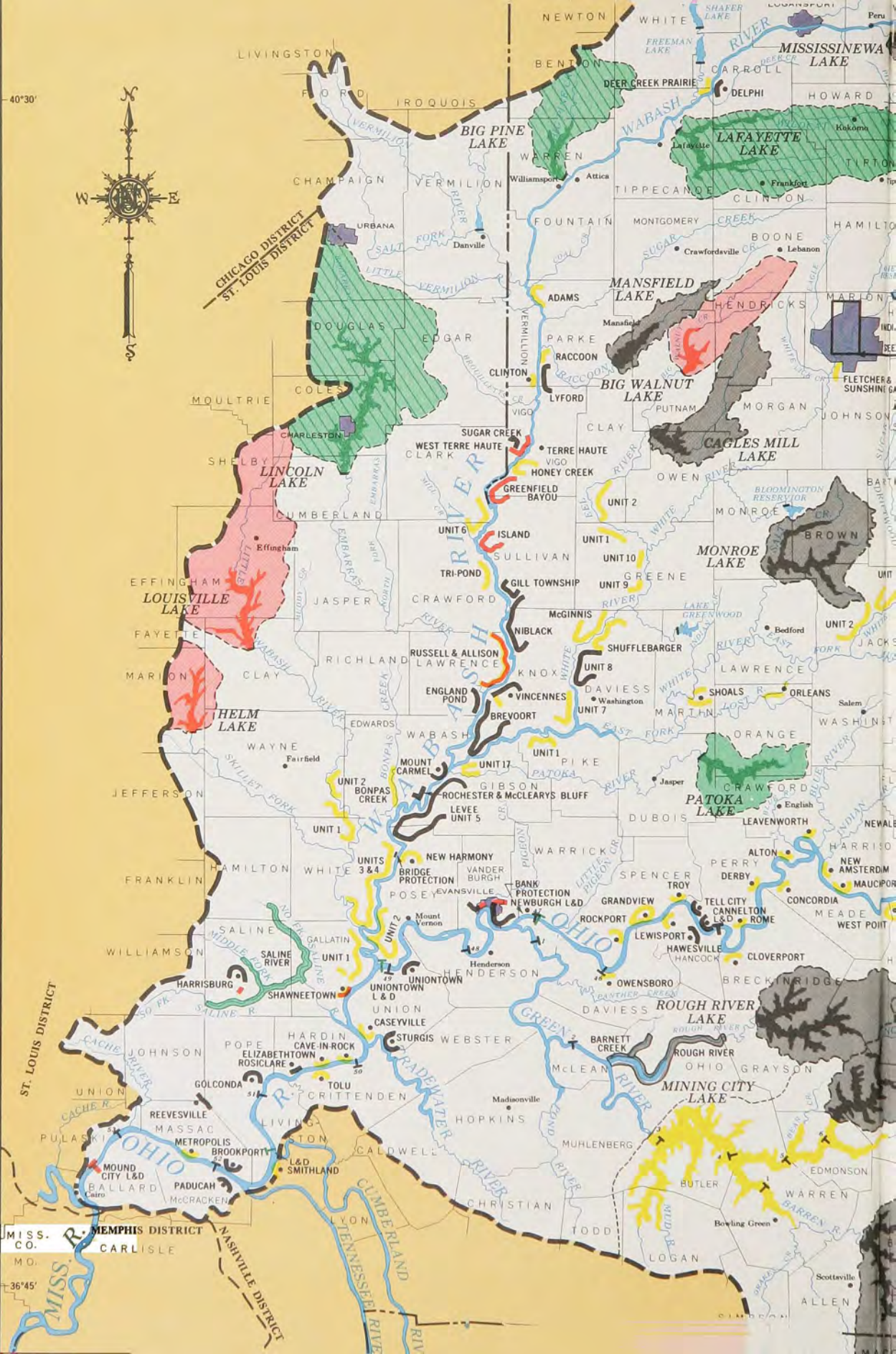
THE FALLS CITY ENGINEERS

A HISTORY OF THE
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
UNITED STATES ARMY

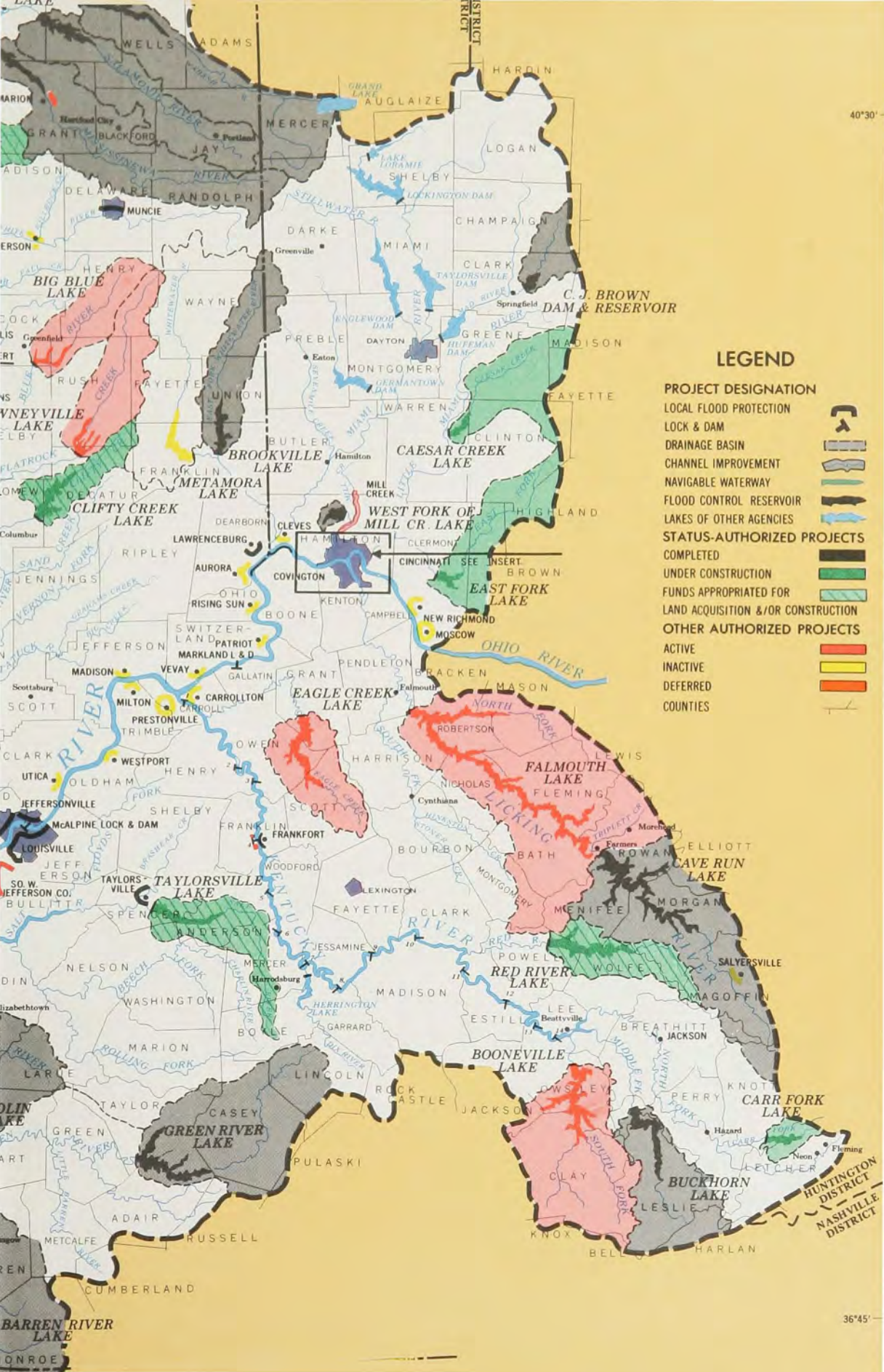
Leland R. Johnson

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MISS. CO. MO. MISSISSIPPI RIVER



LEGEND

PROJECT DESIGNATION

- LOCAL FLOOD PROTECTION
- LOCK & DAM
- DRAINAGE BASIN
- CHANNEL IMPROVEMENT
- NAVIGABLE WATERWAY
- FLOOD CONTROL RESERVOIR
- LAKES OF OTHER AGENCIES
- STATUS-AUTHORIZED PROJECTS
 - COMPLETED
 - UNDER CONSTRUCTION
 - FUNDS APPROPRIATED FOR LAND ACQUISITION &/OR CONSTRUCTION
- OTHER AUTHORIZED PROJECTS
 - ACTIVE
 - INACTIVE
 - DEFERRED
 - COUNTIES

40°30'

36°45'

THE FALLS CITY ENGINEERS

**A HISTORY OF THE
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
UNITED STATES ARMY**

Leland R. Johnson

“The beautiful river Ohio, bounds Kentucke in its whole length, being a mile and sometimes less in breadth, and is sufficient to carry boats of great burthen. Its general course is south 60 degrees west; and in its course it receives numbers of large and small rivers, which pay tribute to its glory. The only disadvantage this fine river has, is a rapid, one mile and a half long, and one mile and a quarter broad, called the Falls of Ohio. In this place the river runs over a rocky bottom, and the descent is so gradual, that the fall does not probably in the whole exceed twenty feet. In some places we may observe it to fall a few feet. When the stream is low, empty boats only can pass and repass this rapid; their lading must be transported by land; but when high, boats of any burthen may pass in safety. Excepting this place, there is not a finer river in the world for navigation by boats.”

By JOHN FILSON, in
“The Discovery, Settlement and
Present State of Kentucke”
published in 1784

FOREWORD

The history of the Louisville Engineer District encompasses more than two centuries of Ohio Valley and American history, with such diverse activities as frontier exploration and mapping, emergency fortification construction during America's major wars, the struggle to open Ohio Valley waterways as channels of commerce, construction of immense navigation, flood control and military base projects, flood fights, and a hundred other missions, all reaching epic proportions. All of us have found the daily work of the District so pressing that we have seldom found time to reflect on where we have been, to place the multi-faceted continuing operations of the Louisville District in its historical perspective, or to consider where we are headed.

In this history of the Louisville District and its distant predecessors we attempt to trace the origins of this institution from its beginnings, when British Army Engineers first explored and mapped the Ohio Valley frontier and Colonel Jonathan Williams, first Chief of the modern Corps of Engineers, descended the Ohio River in a flatboat to direct an experimental Engineer School on what was then the frontier of the United States, through the first primitive efforts to make the inland rivers navigable, to the pioneering canalization projects and the modern flood control and water resource development programs that grew out of the Ohio Valley flood disasters of the early Twentieth Century. The development of the Ohio Valley since its first settlement two centuries ago has been swift. From frontier to a predominantly agrarian section to a balanced industrial-agrarian society, development has proceeded as the population of the region swelled, and the Army Engineers have played an intimate role in that development. A primary goal of this history is to cast new light on the significance of the contributions of the Army Engineers to that development.

Utilitarian review of Engineer operations is a common practice in the Louisville Engineer District, and in this history we have attempted to review the overall program of the District and its predecessors since its genesis, resting on the principle that past experience provides the firmest foundation for improving the efficiency of any organization. Yet the Louisville District is, and has been always, a human institution responsive to human needs, and as such the history of the District is an intrinsically human story, sometimes one of high adventure, sometimes humorous, always turbulent. For two centuries, we, the Army Engineers have devoted ourselves to total performance of the missions assigned to us by the people of the Ohio Valley and the nation, and this is the story of our individual and team efforts, our hopes, our despairs, our successes, our failures, and our sacrifices.

And so, as we review our activities of the past, I can only hope that all of you who have performed so well will strive to meet the continuing challenges.

Louisville, Ky.
24 December 1974

CHARLES J. FIALA
Colonel, Corps of Engineers
District Engineer

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PROLOGUE

The course of the mighty Ohio River has changed many times during the eons of geologic history, but the 981-mile long course of the Ohio as it existed in 1975 remained very much the same as it was when European explorers first discovered the river about three centuries ago. But doubtless these early explorers, were they to revisit the Ohio Valley in 1975, would not recognize the modern Ohio River and many of its tributary streams as being the same rivers they viewed in the seventeenth century, for between 1675 and 1975 a revolutionary transformation occurred in the Valley and on the rivers.

In 1675 the Ohio Valley was, for the most part, covered by virgin forests and dense vegetation; the only human habitations were small, isolated Indian villages; and the sole commerce on Ohio Valley streams was a limited traffic carried on in primitive canoes and dugouts. The Ohio River and its tributaries were wild, scenic rivers, alternately calm and turbulent, subject to great fluctuations ranging from less than a foot deep at extreme low water to more than seventy feet deep at flood time. While these uncontrolled streams were doubtless quite beautiful and clear-running rivers, the many obstructions in their channels, notably the limestone ledges at the Falls of the Ohio, made even primitive navigation hazardous; and the wide range of stream fluctuations from low water to flood stages made living and working on their banks perilous, even to the sparse Indian population dwelling in the flood plains.

By 1975 the dense forests had largely disappeared from the Ohio River Basin; immense industrial centers and urban population concentrations sprawled along the flood plains where once only a few

Indians lived; commerce on Ohio Valley waterways was transported chiefly in enormous tows of barges pushed by powerful diesel tow-boats. The Ohio River and several of its tributaries were regulated by slackwater, lock-and-dam projects to provide more than a nine-foot depth for navigation at all times; and, while fluctuations resulting from a lack, or overabundance, of precipitation still occurred in 1975, the extreme variations in water flow had been leveled out by great reservoir projects which augmented stream flow during low-water periods and reduced the height of flood crests.

As in 1675, the Ohio River in 1975 was still formed by the cold waters of the Allegheny River rushing down from near Lake Erie to unite with the Monongahela rolling down from the Appalachians. The largest tributaries still joined the Ohio from the south and east: from Pittsburgh to Louisville, the Little Kanawha, Great Kanawha, Big Sandy, Licking, and Kentucky rivers dropped from mountain sources to a juncture with the Ohio; below Louisville, warmer waters of the Green, Cumberland, and Tennessee rivers linked the Ohio Valley with the sunny South. The major tributary streams which united with the Ohio from the north — the Beaver, Muskingum, Scioto, Miami, and Wabash rivers — still found their sources near the Great Lakes. These streams, and hundreds of smaller tributary streams, joined together to produce the mighty Ohio River and link the more than two-hundred-thousand square-mile watershed of the Ohio River Basin with the remainder of the inland waterways system of America. But, though an accurate map of the Ohio Basin in 1675 might have resembled a map of the same region in 1975,

very great changes in the regimen of the streams had been effected to meet the demands of a mature and technologically oriented American society.

This is the story of those changes as they were conceived and implemented by the Louisville District, Corps of Engineers, United States Army, and its predecessors — the Cincinnati Engineer District, the Louisville and Portland Canal Company, the Office of Western River Improvements, and individual Army Engineer officers on mission assignment in the Ohio Valley.

The Louisville Engineer District, established on May 11, 1867, has for more than a century engaged in programs designed to enhance the human environment in the Lower Ohio Basin through engineering and technology. Prior to 1867, a quasi-public corporation, the Louisville and Portland Canal Company, created in 1825, was responsible for the improvement of navigation around the hazardous Falls of the Ohio at Louisville; and the Office of Western River Improvements, Corps of Engineers, with offices at Louisville, supervised the improvement of navigation on the Ohio River and other major waterways in the interior of America from about 1824 to 1860. And prior to 1824, even as early as 1766, individual Army Engineer officers performed topographic and hydrographic surveys and completed military missions in the Lower Ohio Valley.

The history of the Louisville Engineer District began in the late eighteenth century when French, British, and American Army Engineer officers constructed fortifications in the Ohio River Basin, surveyed and mapped the Basin, and studied the hydrology and navigational problems of the rivers. The first missions of Army Engineers in the Ohio Valley had therefore a military character, in support of

military units operating on the trans-Appalachian frontier and as a contribution to the security of the first settlements in the Basin, but the work of these early Engineers also had civil applications in that the maps prepared for military purposes became the basis for the numerous guides printed for the pioneers on the way to new homes on the frontier.

About 1824 the officers and civilian personnel of the Corps of Engineers, United States Army, were assigned the mission of improving navigation on the Ohio River and other major waterways to benefit a growing flatboat, keelboat, and steamboat commerce. From 1824 to 1860, this navigation improvement mission was performed intermittently by an Engineer office at Louisville commonly known as the Office of Western River Improvements, directed by Captain Henry M. Shreve and Colonel Stephen H. Long.

From 1860 to 1865, the improvement of navigation was temporarily suspended while Engineer officers and personnel, both Union and Confederate, concentrated on performance of a military mission. But in 1866 and 1867 the project for improving navigation on the Ohio River was resumed; and the Louisville District was established, responsible at first chiefly for the enlargement and improvement of the canal around the Falls of the Ohio at Louisville, but eventually in charge of the improvement of all streams, except the Cumberland and Tennessee rivers, in the Lower Ohio Basin.

In the late nineteenth and early twentieth centuries, in addition to improvements at the Falls of the Ohio, the Louisville District was active in projects designed to provide dependable navigable depths through the construction of canalization, slackwater systems of locks and dams on the main stem of the Ohio River

and several of its tributaries. In 1936, after floods repeatedly devastated the growing population and industrial centers in the Ohio Basin, the Louisville Engineer District was assigned the mission of developing and implementing plans to control floods and reduce flood damages to the human environment within the District's geographic jurisdiction. As a result of numerous expansions of the scope of the flood control mission, as directed by Congress, the Louisville Engineer District was participating in 1975 in an extremely complex and challenging program to develop water resources for multiple purposes — flood control, navigation, water supply, recreation, fish and wildlife conservation, water quality improvement. This comprehensive program for the development of water and related land resources, as it was planned and implemented between 1936 and 1973, was having revolutionary effects on living standards and life quality in the Ohio River Basin, as were similar plans and developments elsewhere in the nation.

As has been the case with many other institutions, the Louisville Engineer District had its beginnings with individuals on special assignments, progressed through a phase in which operations were performed by a small staff directed by a few colorful and independent men — Henry M. Shreve, Stephen H. Long, Godfrey Weitzel, and William E. Merrill — and became, in the twentieth century, a complex, fully staffed organization — a mature institution in which individual personnel were subordinate to and integral components of a corporate-type entity, the "District."

Extending over a period of about two centuries, characterized by increasing complexity of functions and administrative organization, the history of the Louis-

ville Engineer District assumes a somewhat epic character, but retains continuity through several major recurrent themes. This history of the District will focus chiefly on the historic dual military-civil works missions of the Corps of Engineers as reflected by developments within the present Louisville District boundaries; on the administrative and institutional development of the Corps of Engineers as revealed by events in the Louisville District; and on the gradual expansion of the Corps civil works mission from surveying-mapping activities in the late eighteenth and early nineteenth centuries, to the improvement of navigation in the nineteenth and early twentieth centuries, to flood control in the mid-twentieth century, and finally to comprehensive water resource development and the preservation of environmental quality in the late twentieth century. Particular reference will be made to developments at the Falls of the Ohio, the major obstruction to navigation on the Ohio River, from the early studies of the obstructions by Army Engineers, to the activities of the Louisville and Portland Canal Company, 1825-1874, and, at last, to McAlpine Locks and Dam, the structure in place at the Falls of the Ohio in 1975 as an element of the Ohio River Navigation Modernization project.

Before beginning the lengthy, complex, sometimes humorous, and frequently tumultuous history of the Louisville Engineer District, a brief survey of the history of the Corps of Engineers and review of the Corps organization as it existed in 1975 should doubtless be provided to clarify questions which may arise.

French and British Army Engineers operated in North America, a few in the Ohio Valley, prior to the American Revolution. Some of these Engineers joined the Corps

of Engineers, United States Army, when it was established on June 16, 1775, at the outset of the Revolution. The Corps of Engineers went through several reorganizations during its early history; and the modern Corps of Engineers organization dates from an act of Congress of 1802. During the early nineteenth century a distinction was made between Engineers who performed topographic mapping missions and Engineers who directed the construction of fortifications; therefore, in 1813 a Topographical Bureau was established which eventually became the separate Corps of Topographical Engineers. The Corps of Topographical Engineers was merged again with the Corps of Engineers in 1863, when the exigencies of Civil War required that Engineer officers perform both topographic and construction functions. The Army Engineers were first assigned the improvement of navigation on inland waterways in 1824; the Corps has retained this mission, and, in the twentieth century, this limited mission was expanded by Congress to include many other functions relating to water resource development.

The Chief of Engineers, United States Army, with headquarters in Washington, D. C., was, in 1975, the systems manager for engineering support for the Army and also directed the Army Civil Works Program. Prior to 1888, individual Engineer officers reported operations at projects in their charge directly to the Office of the Chief of Engineers (OCE); but in 1888 the Corps decentralized Division-District organization was adopted. Corps Divisions and Districts were essentially administrative and construction field offices; in 1975 there were thirteen Division and thirty-seven District offices, some with jurisdiction for projects outside the continental United States.

Corps activities in the Ohio River Basin were directed in 1975 by the Ohio River Division (ORD), established in 1933 at Cincinnati, Ohio. The Ohio River Division Engineer, usually a General officer, and his staff at Cincinnati provided overall supervision for Engineer operations within the Basin. Within the boundaries of Ohio River Division were four subordinate offices — Engineer Districts — with headquarters at Pittsburgh, Pennsylvania; Huntington, West Virginia; Nashville, Tennessee; and Louisville, Kentucky. Each District was responsible for Corps activities in a geographic section, conforming in general to specific watersheds, of the Ohio River Basin; each was commanded by a District Engineer, who commonly held the rank of Colonel in 1975, reporting to the Division Engineer; and each was staffed primarily by civilian career employees.

The Louisville District's geographic area of jurisdiction could be described as the Lower Ohio River Basin, inclusive of the Wabash, Miami, Licking, Kentucky, Salt, Green, Tradewater, and smaller watersheds, and exclusive of the Cumberland and Tennessee basins. The District staff included a District Engineer, a Deputy District Engineer, military assistants of the Corps of Engineers, and civilian personnel. Employees of the District were stationed either at the District Office in Louisville, or at project management, operation, and construction sub-offices located throughout the District. The District administrative structure included Engineering Division, Planning Division, Operations Division, Real Estate Division, Supply Division, and appropriate branches, plus such specialized units as Office of Counsel, Office of Administrative Services, Personnel Office, and Safety Office. Certainly this complex organiza-

tion was quite different from nineteenth- and early twentieth-century Engineer offices, when Corps functions in a District area were frequently performed by a single Engineer officer, a small staff of clerks and draftsmen, and a few Assistant Engineers in charge of various projects; but the District organization of 1975 was an outgrowth of the earlier administrative structure and was still performing the same functions first assigned to the Corps in the nineteenth century in addition to the duties required by the expanded Corps water resource program.

The information provided above should furnish sufficient background for fuller comprehension of the story of the Louisville Engineer District — the history of Army Engineer activities at Louisville, the “Falls City,” and in the Lower Ohio Basin. It is a story which holds intrinsic interest for each citizen of the Ohio Valley — the “crossroads of America” — because the life of each resident of the region has been touched, directly or indirectly, by the activities of the Louisville District, Corps of Engineers, United States Army.

CHAPTER I: FIRST ARMY ENGINEERS IN THE OHIO VALLEY

The Corps of Engineers, United States Army, traces its origin to an act of Congress of June 16, 1775, authorizing the appointment of a chief engineer and two assistants for the Continental Army. On the day this act passed, Colonel Richard Gridley, a former British Army Engineer who had distinguished himself in previous wars with the French, was engaged in fortifying Breeds Hill near Boston. In the battle which followed on June 17, known as Bunker Hill, Colonel Gridley joined the line and was carried wounded from the field, thereby initiating the construction-combat tradition of the Corps of Engineers, for Richard Gridley became the first Chief Engineer of the United States Army. Many of the first officers of the Corps of Engineers, like Gridley, had learned military engineering in the service of the King, and any studies of the history of the Corps of Engineers must, therefore, begin with the work of Army Engineers during the titanic struggle between the British and French empires for the control of North America and other colonial territories.¹ The same is true of the history of the Louisville District, Corps of Engineers, which administers the Corps program in the Lower Ohio River Basin; it began several years before 1775 and the action at Bunker Hill.

Indians, explorers, traders, frontiersmen, soldiers — all had major roles in the settlement of the Ohio Valley. The Army Engineers also conducted missions which had significant impact on the early history of the valley; an impact which has not received the attention it deserves. Though their activities are shrouded by a paucity of accurate records, members of the French Royal Corps of Engineers were active in the Mississippi and Ohio valleys

early in the eighteenth century. British Army Engineers, notably Lieutenant Thomas Hutchins of the 60th "Royal American" Regiment of Foot, served in the Ohio and Mississippi valleys before the American Revolution; and subsequently such distinguished American Army Engineers as Major Jonathan Williams, first Superintendent of West Point, and Major Stephen H. Long, the famous explorer of the West, led special expeditions down the Ohio River in the early nineteenth century.

The missions of these officers were primarily military: the construction of fortifications, the preparation of topographic and hydrographic maps, and the gathering of military intelligence about the strength of the enemy, whether Indian or European. But these military missions had important secondary civil applications: they provided increased knowledge about the Ohio Valley useful to merchants, pioneers, and river navigators of every variety; they aided in quelling Indian resistance to the incursions of settlers; and they furnished reliable information about a multitude of details, such as the variety of trees encountered, vital to every settler. The dual military-civil mission of the Corps of Engineers was thus foreshadowed by the activities of Army Engineers in the Ohio Valley long before the creation of the Corps of Engineers of the United States Army in 1775.

Waterways of Exploration

Rivers served as the principal transportation and commercial arteries of the explorers and settlers of North America for at least two centuries after the first European settlements were established along the seacoasts. French explorers from Canada

and Louisiana advanced into the interior of the continent via the St. Lawrence River, the Great Lakes, and the Mississippi River and tributary streams. British explorers, like their French contemporaries, also took advantage of waterways in expeditions to the west of the Appalachians. Such use was perhaps natural, since rivers penetrated the dense virgin forests covering the continent east of the Mississippi and usually provided speedier transportation with less physical effort than alternate means — horses and wagons — then available. British explorers and American colonial frontiersmen commonly followed river courses from the Atlantic to their headwaters, cut roads through gaps in the Appalachian mountain chain, and again took to the waterways on the way west. Because the Ohio and its tributaries flow generally in a westwardly direction, they were often used by the early explorers and traders.

Fragmentary evidence indicates that both French and British explorers and traders were traveling the waterways of the Ohio Valley before the end of the seventeenth century. For many years, Robert Cavelier, *Sieur de La Salle*, a French explorer from the St. Lawrence Valley, was acclaimed by historians as the discoverer, about 1669, of the Ohio River, but reexaminations of the evidence have discredited this claim. And the name of the first European to discover and explore the Ohio Valley remains a fertile field for historical investigation.²

The discovery of the Ohio River may be in any case a moot question in that it was discovered, long before the arrival of Europeans, by American Indians at some prehistoric date. Milleniums before De Soto and La Salle first viewed the inland rivers of America, Indians were utilizing those waterways for transportation and

trade in watercraft generally classified as canoes, dugouts, and bull-boats. Canoes were formed of bark peeled from trees and shaped over a frame with pointed bow and stern; dugouts were carved from tree trunks by the judicious application of fire and repeated scraping with stone tools; and bull-boats were constructed by stretching animal skins over a crude wooden frame. These vessels, whose size varied according to the ability and energy of the warriors who constructed them, were commonly used for travel from village to village and for the transportation of such primitive staples as grain and furs. Europeans utilized these rough watercraft in their own explorations extensively; however, the inadequate capacity of such vessels limited their use and they were generally abandoned on the Ohio for the French *bateau* and the American flatboat in the late eighteenth century.³

One particularly interesting example of the use of Indian vessels by Europeans in the Ohio Valley occurred in 1742. A party of four Virginians on an exploration expedition authorized by the colony of Virginia crossed the Appalachians to the Kanawha River in present West Virginia, where they constructed a bull-boat from buffalo hides. They navigated down the Kanawha River to its confluence with the Ohio, down the Ohio past the Falls to the Mississippi, and down the Mississippi, where they were captured and imprisoned by the French. The French did not wish the information gathered about river navigation to get back to British authorities, but one of the prisoners, John Peter Salley, escaped, walked back to Virginia, and wrote an account of his experiences. His description of the Falls of the Ohio was the first accurate account in English of those obstructions, and, because the Falls of the Ohio figure prominently in

the history of the Louisville Engineer District, is perhaps worthy of repetition:

The Falls . . . are three miles long in which is a small Island, the body of the Stream running on the North side, through which is no passing by reason of great Rocks and large Whirlpools, by which we went down on the south side of said Island without much Danger or Difficulty, and in time of a Fresh [flood] in the River, men may pass either up or down, they being active or careful.⁴

In summary, because of the relative ease of transportation by water, in comparison with the then available modes of travel by land, the waterways of the Ohio Valley were commonly used by American Indians before Columbus, were utilized by European explorers whenever possible, and eventually became the principal highways for immigration from the coastal settlements. The crude vessels used by the Indians, the explorers, and later by pioneers and frontier traders were tedious to construct, limited in capacity, and doubtless quite leaky, but they were made of easily-available materials, were light of draft, and well suited to the requirements of primitive tribes and the earliest explorers of the Ohio River Basin.

French Army Engineers

The Royal Engineer Corps of France was foremost in Europe during the seventeenth century. The Marquis de Vauban, Chief of the French Corps of Engineers, was renowned for his expertise in the construction of fortifications — every modern military engineer recognizes his name — and many fortifications in North America were constructed on principles elucidated by Vauban. In addition to military construction, the French Corps of Engineers also constructed civil works, notably canals and locks, to improve the transportation system of the Kingdom of France. The influence of French Army Engineers upon

the early history of the Corps of Engineers of the United States was probably greater than that of the British. Many French Engineers, like Lafayette, came to America during the Revolution to serve in the Continental Army. Two French officers — General Louis LeBègue DuPortail and Lieutenant Colonel Stephen Rochefontaine — served as Chief Engineer of the American Army; French engineering texts were used to train Americans who would be Engineers; French officers from the Napoleonic Army, such as General Simon Bernard and Captain William Tell Pousin, joined the United States Corps of Engineers about 1815 and played an important role in the early civil works program; and French engineering technology had major influence on the design of the Ohio River slackwater system in 1875.

For over a century prior to the American Revolution, French Royal Engineers were active in the Mississippi and Ohio valleys, principally engaged in mapping the region and constructing fortifications. Sieur Remy Reno accompanied a French expedition to the mouth of the Mississippi River in 1698, and may have been the first man trained in military engineering and fortification design to visit the Mississippi Valley. Sieur Le Blond de La Tour, officer of the French Engineer Corps, has been credited with performing the first work to improve navigation — deepening the mouth of the Mississippi — on American inland rivers, and, about 1720, with constructing the first levees for flood control on the Lower Mississippi River. In 1729 a French Engineer, Chaussegros de Lery, made a compass survey of the Ohio River while on a military expedition and the results of his work appeared on a map printed in 1744. But, for the most part, French Engineers in the Ohio Valley devoted their attention to the construction of

fortifications to meet the British threat from the east.⁵

During the series of wars between the British and French in the eighteenth century, culminating with the French and Indian War (1754-1763), as it was known in American colonies, French Engineers designed a chain of elaborate fortifications in the St. Lawrence and Mississippi valleys and around the Great Lakes. Their construction of a fort at the Forks of the Ohio (present site of Pittsburgh) in 1754 to control the Ohio Valley was partly responsible for launching the French and Indian War, the climax to the struggle for empire.

British-American Army Engineers

If George Washington may be considered an Army Engineer, and because of his combination of surveying, fortification, and military experience there is considerable justification for so doing, he was doubtless the first British-American Army Engineer in the Ohio Valley. In 1754, Washington conducted, by orders of the governor of Virginia, a topographic reconnaissance and military intelligence mission into the Allegheny, Monongahela, and Upper Ohio valleys; in the same year, French troops, accompanied by Captain Le Mercier, French Army Engineer, moved to the Forks of the Ohio, where Le Mercier designed and constructed Fort Duquesne to secure the region for the French monarchy. Washington returned to Virginia to report the result of his mission and led troops back to the Upper Ohio Valley to counter the French threat. His defeat on this expedition led to a major war on the North American continent which spread to Europe and around the world in 1756, launching a decisive struggle between the British and French empires which centered in America on control of the St. Lawrence and Ohio

valleys.⁶

Colonel Washington marched again to the Ohio Valley in 1755 as aide to General Edward Braddock. As General Braddock and his command approached Fort Duquesne, the French post at the head of the Ohio, Lieutenant Colonel Thomas Gage and a detachment which included the Indian agent George Croghan and Captain Harry Gordon, British Army Engineer, were in the vanguard of the column when a French and Indian attack from the flanks destroyed the British column as an effective fighting unit. George Croghan and George Washington carried General Braddock from the field and lifted him into a wagon for the retreat.

It was an interesting conjunction of destinies. Colonel Thomas Gage later became commanding general of British forces in North America, ordered Captain Harry Gordon and George Croghan to open the Ohio River to navigation in 1766, and eventually gave the orders which opened the American Revolution at Lexington and Concord. A review of the subsequent life of George Washington is unnecessary here, but perhaps it should be emphasized that throughout his distinguished career he strongly advocated the training of military engineers as a vital component of the American army and supported the improvement of navigation on American waterways. It could be argued, with some justification, that his support for free navigation and government-sponsored improvement of navigation led directly to the writing of the Constitution of the United States.⁷

In 1784, when Washington was engaged in the negotiations which were to culminate in the Constitutional Convention of 1787, he wrote to the President of Congress to support improved navigation and canal construction:

The Assemblies of Virginia and Maryland have now under consideration the extension of the inland navigation of the rivers Potomac and James, and opening a communication between them and the Western waters: they seem fully impressed with the political as well as the commercial advantages which would result from the accomplishment of these great objects; and I hope will embrace the present moment to put them in train for speedy execution. Would it not at the same time be worthy of the wisdom and attention of Congress, to have the western waters well explored, the navigation of them fully ascertained, accurately laid down, and a complete and perfect map made of the Country; at least, as far westwardly as the Miamies running into the Ohio and Lake Erie; and to see how the waters of them communicate with the river St. Joseph which empties into the Lake Michigan, and with the Wabash? I cannot forbear observing here, that the Miami Village on Hutchins map, if it, and the waters here mentioned are laid down with any degree of accuracy, points to a very important post for the Union.⁸

A careful reading of Washington's words reveals that in 1784, after a study of "Hutchins map," he had become interested in a project which, in the Louisville Engineer District in the mid-twentieth century, was to be known as the Cross-Wabash Waterway. Another distinguished Virginian, Thomas Jefferson, was also studying Hutchins' map at about the same time. He wrote that, without qualification, the "*Ohio* is the most beautiful river on earth. Its current gentle, waters clear, and bottom smooth and unbroken by rocks and rapids, a single instance only excepted." The "single instance" was the Falls of the Ohio, and Jefferson speculated that these obstructions might be opened for constant navigation by clearing the channel nearest the Virginia (Kentucky) shore.⁹

Hutchins' map is a subject which often recurs in the early history of the Ohio Valley; it was probably the most accurate map of the Ohio River in existence until 1821. A visitor in the Ohio Valley in 1783 wrote

that any immigrants to the region should acquire a copy of Hutchins' map: "He travelled through these parts before the war, under orders from the British government, and his is the best and only map of that country." The Hutchins' map was used by commissioners from the United States who treated with the Indians of the Old Northwest; descriptions of the Ohio Basin written by Hutchins were printed and reprinted in eastern newspapers to provide information for those who might go there; the Hutchins' map was supplied to British and later American combat units on expeditions down the Ohio River and up its tributaries. Thomas Hutchins, one of the most neglected figures in American frontier history, was an Army Engineer.¹⁰

Thomas Hutchins, a native American born in New Jersey, began his military career in the British army. He joined the Pennsylvania militia during the French and Indian War and participated in the expedition led by General John Forbes which finally captured Fort Duquesne at the Forks of the Ohio in 1758.¹¹ Hutchins probably read the jubilant dispatch from the headquarters of the British army after its occupation of Fort Duquesne:

Blessed be God, the long look'd for Day is arrived, that has now fixed us on the Banks of the *Ohio* with great Propriety called *La Belle Riviere*. in the quiet and peaceable Possession of the finest and most fertile Country of *America*, lying in the happiest Climate in the Universe. This valuable Acquisition lays open to all his Majesty's Subjects a Vein of Treasure, which, if rightly managed, may prove richer than the Mines of *Mexico*¹²

It is likely that Thomas Hutchins would have agreed with every word of the dispatch, for he was to spend the remainder of his life surveying, mapping, and traveling the Ohio Valley from end to end. After the capture of Fort Duquesne, Hutchins served for a time with George Croghan as

an Indian agent, then accepted a commission as Ensign in the 60th Regiment of Foot, the "Royal Americans," a combat infantry unit with a complement of men from every section of the American colonies. His actual service, however, was as Engineer on the staff of Colonel Henry Bouquet. With Captain Harry Gordon, Hutchins participated in the design and construction of Fort Pitt, and later in its defense against Indian assault. When Colonel Bouquet marched his command across the Upper Ohio Valley to the Muskingum River to deal with the Indians of the Pontiac Conspiracy, Thomas Hutchins directed the cutting of roads and the building of bridges to facilitate the movement.¹³

Mapping the Ohio

Though the Treaty of Paris, 1763, had given the British crown legal possession of the Ohio Valley and Illinois, as late as 1765 these lands were still in the hands of the French and their Indian allies. This was chiefly the result of continued Indian resistance under the leadership of Chief Pontiac and the dearth of reliable information about the transportation routes and topography of the region. From 1763 to 1765 three British expeditions attempted to reach the French posts in Illinois via the Mississippi from the Gulf and overland from Detroit; each was hampered by the slow progress made upstream on the Mississippi or on the overland route and was turned back by the Indians before accomplishing its mission.

In the spring of 1765, George Croghan and a few Indian allies were sent down the Ohio to treat with the Indians and open the Ohio River route to Illinois. The expedition was attacked near the mouth of the Wabash and taken captive up the Wabash to Vincennes and Ouiatanon, but

Croghan was able to convince the tribes they would receive no further aid from the French and negotiated a truce with Chief Pontiac. In August, 1765, a British detachment commanded by Captain Thomas Stirling followed Croghan's route down the Ohio, and, in spite of low water, was able to reach Illinois and take possession for the British Empire. Shortly thereafter another British unit reached Illinois from New Orleans, after a five-month trip up river against the current of the Mississippi.¹⁴

It became apparent to the British command that if it wished to reinforce and supply the troops in Illinois, and thereby retain possession of the region, it was vital that maps of the Ohio River be prepared as a guide for future expeditions and supply convoys. General Thomas Gage directed that a supply expedition be organized at Fort Pitt and ordered that Captain Harry Gordon, chief engineer, and his assistant, Ensign Thomas Hutchins, join the expedition. Gordon and Hutchins were assigned the mission of mapping the Ohio during the passage down river, noting the width and depth of the water, the speed of the current, and camping sites which might be made reasonably secure from surprise Indian attack. General Gage further explained and ordered:

As the greatest Benefit that can accrue from being in possession of the Illinois will be to watch the Motions and designs of our opposite Neighbours, whether French or Spaniards and to prevent their Traders introducing foreign Merchandise into His Majestys Territorys and by secret intrigues spiriting up the Indian Nations to commit hostilities on His Majesty's Subjects, and as it will be also necessary to check any evil designs that the French Inhabitants may have who have chosen to remain on their Lands in those Territorys that have been Yielded to Great Britain, You will be carefull in Your Examination of that Country of which you will take as exact a Survey as time and circumstances will allow, that we may fix

upon the best and most Advantageous Spots for such Fortifications as shall be found necessary to Answer the purpose above mentioned.¹⁵

The mission of the British Engineers therefore included topographic and hydrographic reconnaissance to aid in establishing logistic lines, gathering military intelligence useful to the army, and the selection of sites for fortification construction. After surveying the Ohio River and the Illinois country, the Engineers were instructed to descend the Mississippi, observing the strength of foreign fortifications, ascertaining the number of troops in each garrison, and estimating the strength of Indian tribes in the region. At New Orleans, they were to declare their "amicable intentions" to Spanish authorities, then proceed to inspect British posts at Mobile and Pensacola, and finally to return to the Atlantic coast by sailing vessel and report.¹⁶

Captain Gordon and Ensign Hutchins joined the supply expedition at Fort Pitt; it consisted of seventeen bateaux, the largest fleet of British vessels ever to navigate the Ohio River. The mercantile firm of Baynton, Wharton, and Morgan of Philadelphia, which planned to contract for army supplies and trade with western Indian tribes, had established a boatyard at Pittsburgh for the fabrication of galley bateaux and other watercraft in 1765, and doubtless furnished the boats for the expedition, for thirteen of them were laden with the firm's supply and trading goods. George Morgan, junior partner in the firm, joined the expedition to look after the company's interests. George Croghan, the Indian agent, and over a hundred of his Indian friends, also accompanied the expedition; he planned councils with the western tribes, where he would distribute the customary presents from the British government.¹⁷

There were several interesting connections between the leaders of the expedition. Hutchins had previously served for a time as assistant to Croghan as Indian agent. Croghan and Captain Gordon had become acquainted during the Braddock expedition and were partners in real estate speculation. Croghan was also a silent partner in the Baynton, Wharton, and Morgan company, but this was concealed for such an arrangement between Indian agents representing the government and private traders was an illegal, though common, method of conducting the Indian trade. These relationships suggest the multiple military and civil purposes of the expedition. Croghan was to conciliate the hostile tribes with gifts, if possible; and if not he had over a hundred friendly warriors to defend the expedition. Morgan was in charge of supplies for sale to the British garrison in Illinois; he also had goods for use in opening the Indian trade. The Army Engineers were to map the Ohio River for use by future supply expeditions and in future military operations; their map could also be used by trading firms and others interested in navigating the river. No mention was made in the records of the expedition of planning for future settlement, but doubtless the subject received some consideration, for Croghan and Gordon were engaged in real estate speculation at the time and Hutchins and Morgan later planned a settlement near the mouth of the Ohio.

On June 18, 1766, to the sound of cannon salute from Fort Pitt, the flotilla, with four men at the oars of each bateau, set off down the Ohio. It must have been a colorful sight, with over a hundred Iroquois, Delaware, and Shawnee Indians in paint and feathers, George Morgan and his men in rough frontier clothing, and Thomas Hutchins probably wearing his scarlet and

blue regimentals for the occasion. Because Hutchins traveled in a more maneuverable bateau to facilitate the gathering of information for his map, George Morgan boarded the Hutchins bateau; Morgan hoped thereby to gain more information of use to his firm about the navigation of the river. The fleet averaged about forty miles per day, moving only during daylight hours. It was delayed, however, by the grounding of boats on bars — one of Morgan's men drowned while attempting to free a boat from a bar — by the necessity of stopping to hunt buffalo for food, and on June 28 it was forced to the bank by a violent storm.¹⁸

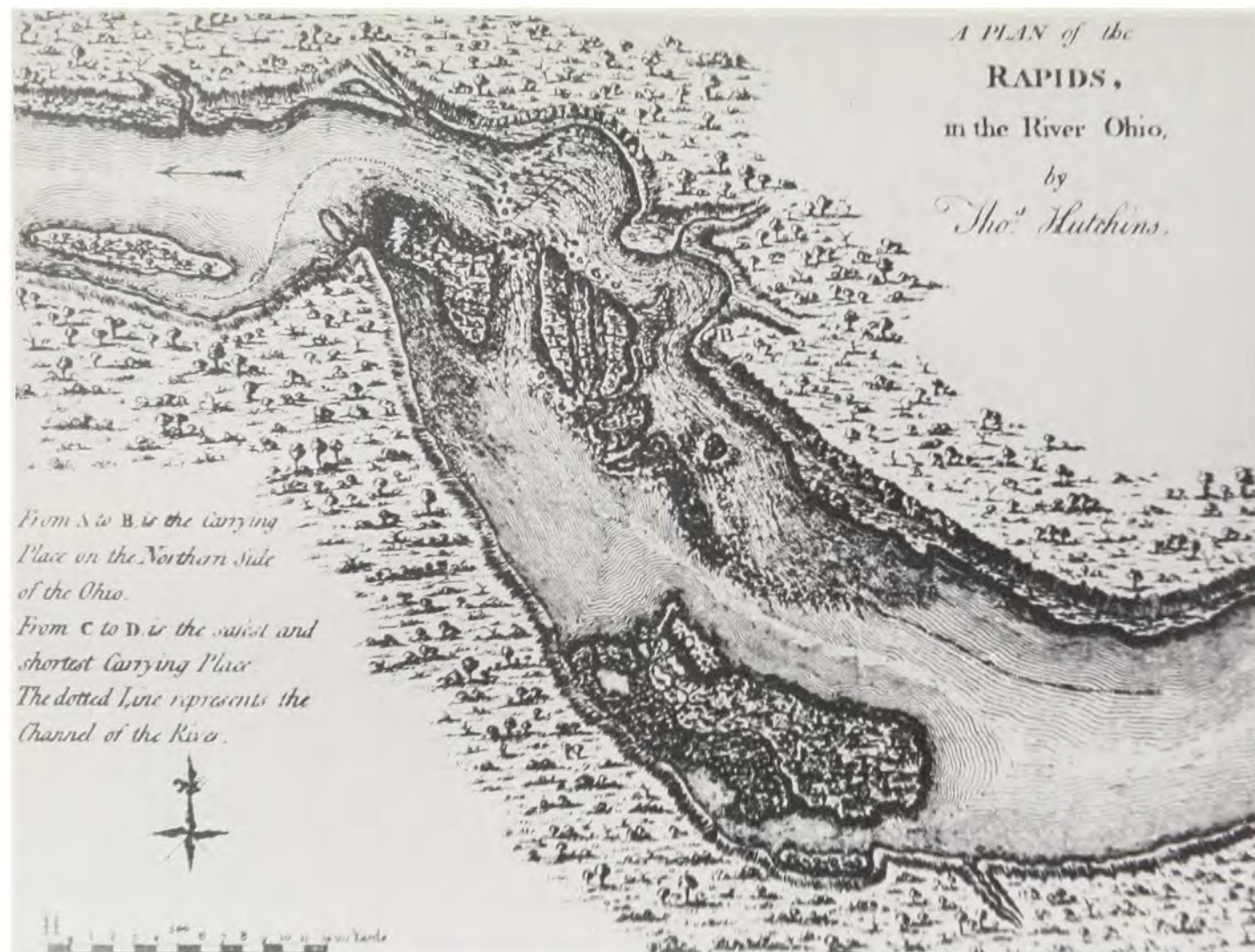
The expedition halted at the mouth of the Scioto River for about a week while Croghan conferred with Indian leaders, then proceeded to the Falls of the Ohio. Captain Gordon observed the Falls of the Ohio did not deserve the name "Falls" because there was no precipitous cataract, merely rapids over a "ledge of flat limestone rock, which the Author of Nature put here to keep up the waters of the higher Ohio, and to be the cause of that beautiful stillness of that river's course above." A portion of the freight was unloaded above the Falls and reloaded below after the boats had successfully navigated the channel nearest the right (Indiana) bank.¹⁹

The expedition arrived at the mouth of the Ohio on August 7, where the Engineers checked their map with latitude readings, and turned up the Mississippi, arriving at Kaskaskia, British headquarters in Illinois, on August 19. The Engineers continued their survey up the Mississippi to the mouth of the Illinois River, then navigated the Mississippi to New Orleans and returned by sea to the Atlantic coast to make their report. General Gage had the map of the Ohio River copied and distributed to the appropriate commanders.

The map was the first detailed hydrographic study of the Ohio River and provided information about many topographic features. The accompanying report provided reliable information about the number and character of the Indians, the strength of Spanish posts, and accurate appraisals of possible transportation routes and likely sites for fortifications — precisely the sort of information necessary for proper policy-making and troop-disposition planning. Also extant in the surviving Hutchins' papers is a detailed plan for an assault on New Orleans, but whether he prepared it as part of his report of 1766, or at a later date is not clear.²⁰

In 1767 Hutchins rejoined the Royal American Regiment at Fort Pitt, and in 1768 he accompanied his regiment on a second voyage down the Ohio, apparently acting as guide. In 1769 he constructed an armed bateau, rowed with twenty-four oars, capable of transporting thirty-five troops and six-months provisions, and mounting a six-pound cannon on the forecastle. It was designed to patrol the Lower Ohio and its tributaries to curtail activities of foreign traders and hunters who were slaughtering buffalo and inciting the Indian tribes. The extent to which this vessel, the *Gage*, was used is uncertain, though General Gage did report that Hutchins narrowly escaped an Indian attack while in a patrol boat on the Ohio in 1771.²¹

Hutchins later directed the construction of British fortifications at Pensacola, Florida, was elected a member of the American Philosophical Society, and was promoted to the rank of captain in the British Army. At the onset of the Revolution he was in London preparing his map of the Ohio Valley and his journals for publication; they were published in 1778, and for many years were the only reliable



Map of the Falls of Ohio made by Thomas Hutchins, British Army Engineer, in 1766. Copied from Thomas Hutchins, *Topographical Description of* (London, 1778), in Library of Congress.

printed source of information about the Ohio Valley frontier. Selections were reprinted in American newspapers for the information of those planning to relocate in the Ohio Valley, and the information and map were used, often without credit, by a number of early geographers and such publishers as Zadok Cramer who printed guides for the use of navigators on the Ohio River and its tributaries.²²

While in London Captain Hutchins engaged in business correspondence with Samuel Wharton, a partner in the firm of Baynton, Wharton, and Morgan of Philadelphia, who was a part of the American intelligence organization during the Revolution. British counterintelligence learned of the correspondence, arrested Hutchins, and clapped him in irons under charges of treason. These charges were unsubstantiated and Hutchins was released; however, he fled Britain to France to join the Revolution. With a letter of recommendation from Benjamin Franklin, he departed France as secretary to John Paul Jones aboard the *Alliance* to return to America and join the Engineer Corps of the Continental Army. At the close of the war, Hutchins was appointed "Geographer to the United States," which, it has been claimed, made him the first "Chief of Topographical Engineers, U. S. Army." After the enactment of the Land Ordinance of 1785, Hutchins and a corps of assistant surveyors, with protection from Indian attack provided by troop detachments, began the survey of the territory north of the Ohio River in preparation for its sale and eventual settlement. Just before his death in 1789, Hutchins associated with his old friend, George Morgan, in planning the establishment of a colony at New Madrid (Missouri) near the mouth of the Ohio.²³

The exploration and mapping of the

Ohio Valley frontier was Hutchins' life for over thirty years. As soldier and Army Engineer, as Indian agent and "Geographer to the United States," he repeatedly navigated the Ohio River and its tributaries and walked the country from the Great Lakes to the Gulf, always making careful note of river navigation and hydrology, natural resources and climate, and other details which might be of value to either military authorities or civilian pioneers and entrepreneurs. His work had an incalculable, but major, influence on the opening and settlement of the Ohio Valley.

American Army Engineers

In the demobilization which followed the Revolution, the Corps of Engineers, like most of the Continental Army, was disbanded. Until a major war again threatened the nation in the second Washington administration, no Army Engineer organization existed, and the veteran Engineers of the Continental Army went into private business, or took employment on the various state projects for internal improvement.²⁴

The postwar career of one former Engineer officer is of special interest to historians of the Ohio Valley. Colonel Rufus Putnam, a veteran of the French and Indian War who had become the second Chief Engineer of the Continental Army, was an organizer of the Ohio Company, founded in Boston in 1786, which requested the granting of public lands in the Ohio Valley for veterans and their families. Congress granted one and a half million acres of land, lying in the present state of Ohio, to the Ohio Company; and in 1788 Colonel Putnam, aboard the galley *Mayflower*, led a group of settlers down the Ohio River to found the town of Marietta. There, Putnam directed the construction of "Campus Martius," a formida-

ble fortification designed to repel Indian attack, which it did on several occasions. He was later appointed Judge of the Northwest Territory and in 1796 was appointed Surveyor General of the United States.²⁵

When another major war between Great Britain and France threatened to involve the United States in 1794, Congress authorized the raising of a composite Corps of Artillerists and Engineers of four battalions strength. Several of these units saw service in the Ohio Valley during the closing years of the eighteenth century, and a few Engineer officers navigated and studied the Ohio River during this period.²⁶

Major Jonathan Williams, Second Regiment of Artillerists and Engineers, was assigned a topographic and fortification mission in the Ohio Valley in 1801. Major Williams was related to Benjamin Franklin, and had acquired his engineering education in Britain and France while serving as Franklin's private secretary and as supply officer and inspector for the Continental Army at Nantes, France, from 1770 to 1783. At the end of the Revolution Williams returned to the United States, took a degree at Harvard College, and became associated with Franklin at Philadelphia in experimental science. In 1801 he was commissioned in the Corps of Artillerists and Engineers. His first assignment was to proceed to the trans-Appalachian West to inspect fortifications, recommend improvements and select sites for new posts, and plan military roads. He examined posts in the Niagara area, and on May 1 arrived at Pittsburgh for the expedition down the Ohio.²⁷

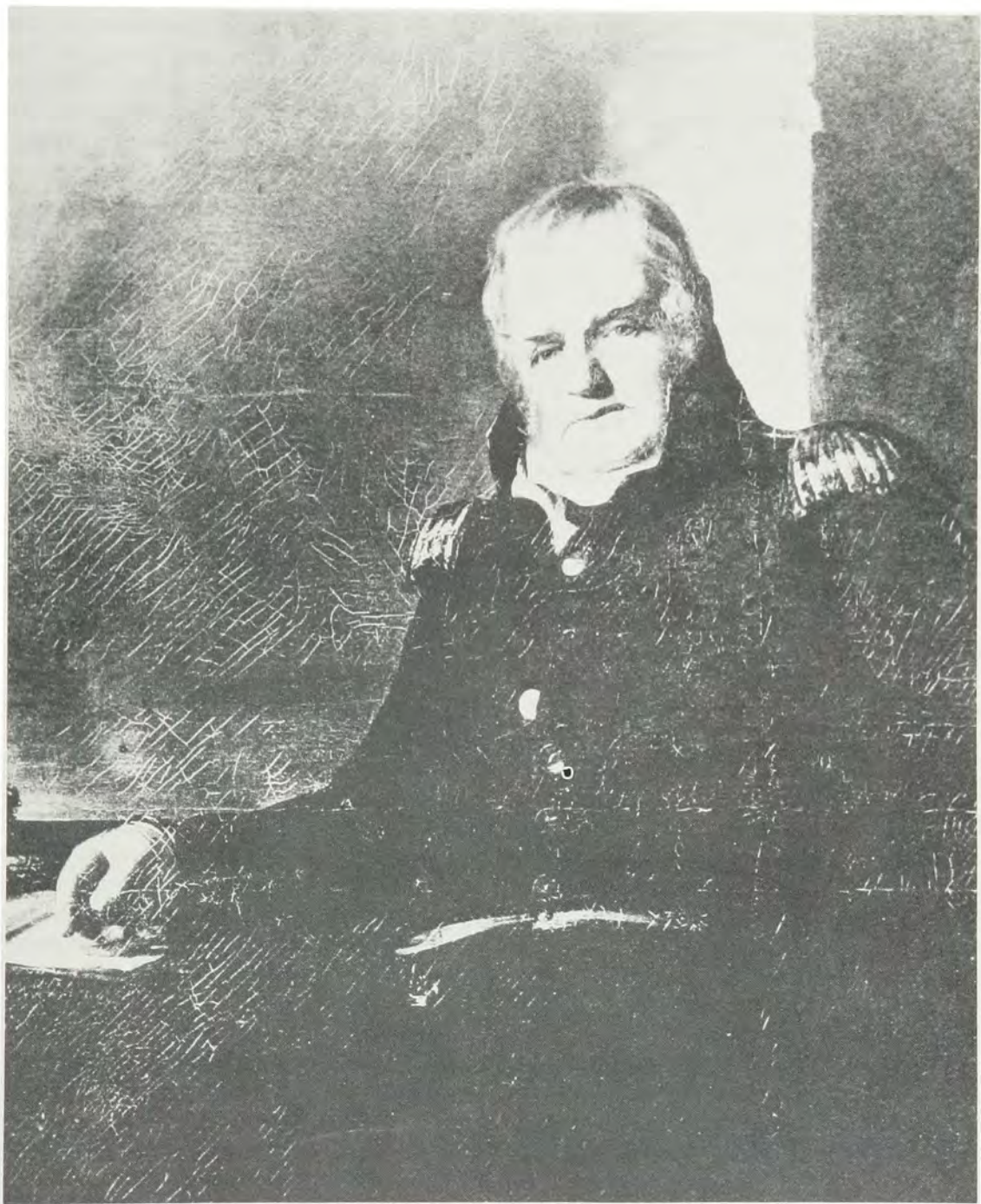
He embarked at Pittsburgh on July 2, 1801, in command of three very large flatboats. One transported horses and dragoons; another carried troops of the

Second Regiment of Artillerists and Engineers, plus a fourteen-piece band which the commanding general, James Wilkinson, had ordered to the front; and in the third were some new recruits, Major Williams, and his two assistants, Lieutenant John De Barth Walbach and Lieutenant Alexander Macomb (later Chief Engineer, U. S. Army, 1821-1828). At the beginning of the voyage Major Williams had some trouble with the recruits, who were "beastly drunk," but after he settled this problem the trip down river was quite pleasant. The boats traveled day and night, making an average progress of seventy miles per day, and entertainment was provided by the general's band.²⁸

Lieutenant Macomb sketched the interesting features of the Valley, and Major Williams made extensive notes about all he saw during the expedition. He was especially impressed by rapidly increasing population of the Ohio Valley. "They may in less than a Century," he predicted, "defy the power of the world. The Ohio may in that time represent what the Rhine is now In point beauty, lastly of navigation, & fertility of soil, it must be preeminent . . ." ²⁹

The flotilla reached Louisville on July 13 and employed a Falls pilot to guide the boats through the rapids. The description of the Falls of the Ohio written by Major Williams further clarifies the navigational difficulties at that point:

The Ohio in point of convenience & safety is (except in this spot) the best in the world but here at the Falls it is among the worst of navigable Rivers at this season of the year. It is divided into 3 *Chutes* . . . & in a distance of 2 mile falls 22½ feet perpendicular but not in equal gradation. Two of the *Chutes* are now nearly dry. The Islands that divide them although there are some remnants of Trees are merely Land Banks, and in great freshe[ts] are probably over flowed. The remaining Chute becomes more rapid in proportion as



(U. S. Signal Corps Photograph)

COLONEL JONATHAN WILLIAMS

the water is more confined, and when we passed with our Boat we had not six inches to spare, between the Rocks, all three Boats however passed very safely having first by dividing our loading among the Boats made them all draw alike but about 12 Inches of Water. In passing the most dangerous part of the Falls we went with such rapidity that the distance of about a mile & $\frac{1}{4}$ was performed in 4 minutes. What would you think at seeing a floating House carried with that rapidity through such a narrow passage where the deepest water over the Rocks is not 2 feet & when we had not 6 Inches to spare between them?³⁰

Major Williams and his fleet arrived at Cantonment Wilkinsonville, a troop-training camp at the Grand Chain of rocks about eighteen miles above the juncture of the Ohio and Mississippi, on July 29. There, Major Williams directed the Second Regiment of Artillerists and Engineers in artillery practice and experiments with ordnance. He also laid out a fortification about five miles further down the Ohio (near the present site of Lock and Dam No. 53, Ohio River), which was never constructed. The garrison at Cantonment Wilkinsonville was suffering numerous fatalities from epidemic fever at the time Major Williams arrived, and at the death of the commandant, Major Williams became commanding officer of the post. Because of the fever epidemic and other considerations, Cantonment Wilkinsonville was abandoned in late 1801, and Major Williams returned to Louisville by poling a canoe up the Ohio for eighteen days.³¹

By 1801 it had become evident that the composite Corps of Artillerists and Engineers was not a satisfactory organization; that the officers were not receiving adequate training in the science of military engineering, which required much more than the construction of artillery emplacements. Support had developed in Congress for separating the two branches and creating a national academy for train-

ing Army Engineers. Secretary of War James McHenry expressed this opinion to the House of Representatives in 1800 and added that highly-trained military engineers could have multiple benefits for the nation:

We must not conclude, from these observations, that the services of the engineer is limited to constructing, connecting, consolidating, and keeping in repair fortifications. This is but a single branch of their profession, though, indeed, a most important one. Their utility extends to almost every department of war, and every description of general officers, besides embracing whatever respects public buildings, roads, bridges, canals, and all such works of a civil nature. I consider it, therefore, of vast consequence to the United States, that it should form in its own bosom, and out of its own native materials, men qualified to place the country in a proper posture of defence, to infuse science into our army, and give our fortifications that degree of force, connexion, and perfection, which can alone counterbalance the superiority of attack over defence.³²

On March 16, 1802, President Thomas Jefferson, doubtless influenced by the reasoning that trained personnel of the Corps of Engineers could perform both civil and military construction, signed into law the bill establishing the modern Corps of Engineers and the United States Military Academy at West Point. Major Jonathan Williams had returned from Louisville to the East, and he was appointed first Superintendent of West Point and first Chief Engineer of the modern Corps organization. Supervision of the military academy at West Point was to remain the responsibility of the Chief of Engineers until 1866, and every Chief Engineer of the United States Army until the Civil War was trained at West Point by Jonathan Williams before he retired from the service in 1812.³³

During the first decade of its existence, personnel of the Corps of Engineers, in addition to purely military duties, per-

formed services, such as surveys for roads and canals, of a civil character. The first major civil works construction responsibility of the Corps was the Cumberland, or National, Road, forerunner of the national highway system, which crossed the Appalachians from Maryland to the Ohio Valley and eventually traversed southern Ohio, Indiana, and Illinois. During the War of 1812, Army Engineers performed military missions in practically every combat theater. These duties principally consisted of fortification construction, topographic reconnaissance, and map production. Because fortification construction materially differed from reconnaissance and mapping functions, a separate organization, the Topographical Bureau, later the Corps of Topographical Engineers, was established in 1813 and charged with meeting the Army's mapping requirements. Though cooperation between the Topographical Engineers and the Corps of Engineers was close and their civil works responsibilities often overlapped, the two agencies retained their separate organization until 1863 when they were again amalgamated.³⁴

Summary

Though the Louisville District, Corps of Engineers, traces its continuous existence back only to 1888, or perhaps 1867, Army Engineers — French, British, and American — conducted missions in the Ohio Valley long before it was settled and even before the Corps of Engineers, United States Army, was first established in 1775. Foreshadowing the modern dual mission — military construction and civil works — of the Corps of Engineers in the Ohio Valley and elsewhere, the early Engineer activities in the Ohio Valley and within the present boundaries of the Louisville Engineer District were military in character

but had extensive civil application. The work of such Army Engineers as George Washington and Thomas Hutchins in the Ohio Valley before the American Revolution, and their continued interest in the region after the war, had an unassessable but without doubt significant influence on the conquest of the valley by the British Empire and its subsequent settlement by Americans.

The role of Washington in opening the Ohio Valley for Virginia and the British Empire, his subsequent support for studies of the region — its resources, its topography, its navigable rivers — and his political and financial support for the development of transportation routes to link the original colonies and states with the trans-Appalachian West can never be overlooked in any history of the first frontier. Neither should the work of Thomas Hutchins be neglected, for his topographic studies did much to facilitate the navigation of the Ohio, both for British and American troops and for the early settlers and merchants. These activities were not authorized by the British government for other than military purposes; yet, they did foster the subsequent settlement and development of the Ohio Valley.

The work of Thomas Hutchins in the Old Northwest after the Revolution was a deliberate effort by the United States to facilitate settlement of the region; such settlement would secure American control of the newly-won West and stimulate the sale of public lands. The work of the Corps of Artillerists and Engineers on the Ohio Valley frontier in the waning years of the eighteenth century, as part of an overall national policy for the removal of the Indian threat to the settlements and the countering of possible ventures in the region by neighboring powers, was also conducive to settlement and development of

the region, by increasing the security of the new homes being quickly hacked from the forest.

Recent studies of the history of the trans-Mississippi West and Far West have recognized the significance of the deliberate governmental policy of fostering settlement and development of those regions through exploration and mapping activities conducted by Army Engineer of-

icers.³⁵ Perhaps somewhere in the history of the Ohio Valley frontier, along with Indians, explorers, traders, frontiersmen, and pioneers, room should be made for the Army Engineers. It is worthy of note that topographic and hydrographic surveys and studies were to be a continuing mission of the Corps of Engineers and the Louisville Engineer District in the Ohio Valley as elsewhere.

CHAPTER II: OHIO RIVER NAVIGATION, 1783-1824

No history of the activities of the Corps of Engineers in the Ohio River Valley could be complete without a review of the historic development of waterways navigation and waterborne commerce in the valley, for the major continuing mission of the Louisville Engineer District and its predecessors has been the improvement of waterways as a benefit to navigation. Congress first assigned the improvement of inland rivers to the Corps in 1824, but officers of the Corps, during the performance of their military missions in the Ohio Valley, often reported the condition of the unimproved waterways and described the character of the waterborne commerce prior to 1824. And one of them, Major Stephen H. Long, made significant contributions to the design of the western inland river steamboat. Before recounting the history of the improvement of the Ohio River for navigation, a review of the development of navigation on the Ohio River prior to 1824 is in order.

Condition of the Ohio River Prior to Improvement

Early descriptions of the Ohio River emphasized its navigability, often stating that no serious problems were met in traveling the river except at the Falls. It was, however, not quite as simple as described, for early navigators used light-draft canoes, dugouts, skiffs, and bateaux and did not consider grounding on a bar a serious mishap. Navigators of a later period, who used deeper-draft vessels, were to continually complain of shallow channels, shifting bars, hazardous rocks and snags, and similar obstructions. As the Ohio Valley was settled and extensive use of the rivers for marketing agricultural produce and manufactured goods de-

veloped, obstructions to navigation, because of resultant delays and losses of boats and their cargoes, became more objectionable.

The navigability of Ohio Valley waterways, before 1824 the principal outlet to market, was a matter of great personal concern to the early settlers. In its natural condition, the Ohio River had a constantly changing channel. Annual floods shifted the location of sand and gravel bars, created and destroyed islands, cut new channels and filled old, undermined banks and toppled entire trees into the stream. The river was alternately calm and tumultuous, wildly fluctuating from one foot deep at extreme low water up to eighty feet at record flood stages. In 1838 the entire flow of the river just below Pittsburgh was measured at 1400 cubic feet per second (cfs); at the crest of the 1937 flood about 900,000 cfs poured past Cincinnati into Louisville. From its head at Pittsburgh to its mouth at Cairo, the Ohio ran down a slope with a total fall of 429.4 feet, but the fall was not uniformly distributed. Long pools with a negligible fall alternated with "riffles," or rapids, where the gradient was steep; more than twenty feet at the worst place — the Falls of the Ohio. The natural condition of the tributaries of the Ohio River was generally no better, if not worse, for navigation than that of the Ohio, and traffic originating on tributary streams ordinarily used a portion of the Ohio on its way to port cities and markets.¹

Though a water stage of a mere three feet was considered navigable by early rivermen, this depth was not available on the Ohio for several months each year. Low-water stages usually prevailed in the Ohio Basin from July through October;

during that season only the shallowest-draft vessels operated, and they often were delayed by teams and wagons fording the river at many points. Until railroads crisscrossed the region in the mid-nineteenth century, business practically came to a halt during low-water seasons, manufacturers laid off their employees, and a mini-recession set in, lasting until the river rose. Rivermen and shippers came to rely on two rises: the fall rise which occurred in late October or November, and, after an interval of severe weather and ice conditions, the spring rise in February, March, or April. During such stages, the Ohio Valley waterways teemed with vessels transporting commodities to down-river markets, and, later, to up-river ports via keelboat and steamboat.²

Agricultural enterprise has always been seasonal; its success intimately connected with the amount and timing of precipitation. As long as Ohio Valley mercantile and manufacturing concerns relied chiefly upon the unimproved waterways for transportation of raw materials and salable products, their success was also dependent upon the amount and timing of precipitation. If the fall rise was delayed, or did not occur at all as happened in 1819, a transportation crisis developed and economic consequences were serious. The unpredictable Ohio River continually disrupted business affairs and community life as long as alternate commercial routes were unavailable; however, transportation costs via the unimproved waterways as compared with the existing overland facilities were so much lower that the unreliable channels of the Ohio River and its tributaries were used almost exclusively by commerce until about 1850.³

Flatboats and the Great Immigration

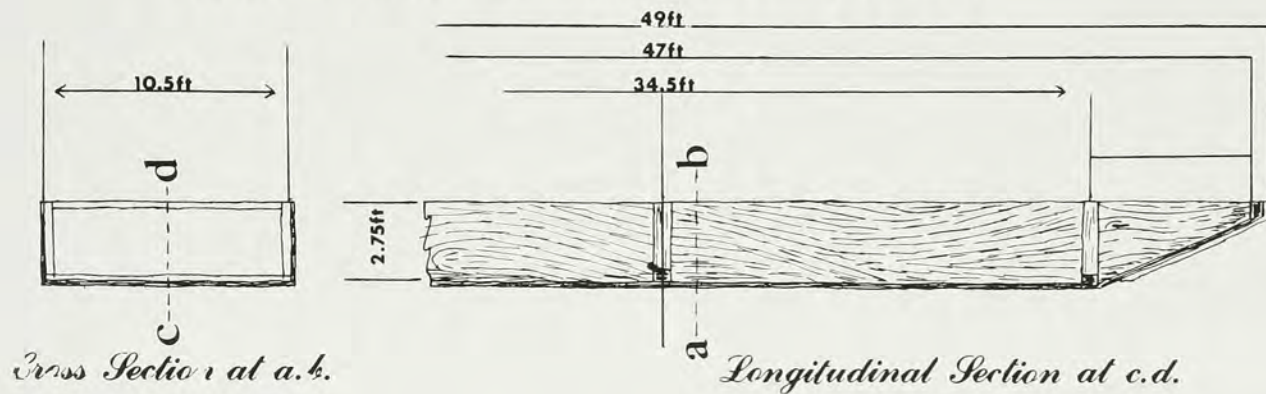
The Ohio River flatboat, originally

merely a large sturdily-constructed wooden box, has been well described as the "ark of empire." Major Jonathan Williams, Corps of Engineers, traveled in them down the Ohio in 1801 and described them as resembling a "floating house." In 1802 another traveler described them more fully:

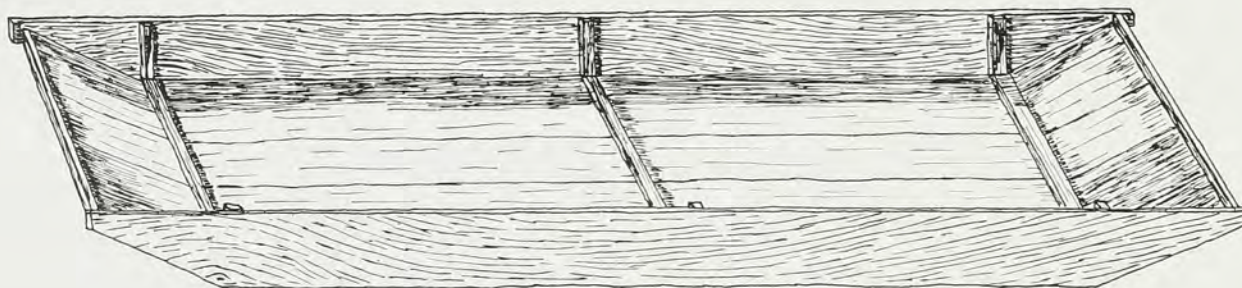
They are of a square form, some longer than others; their sides are raised four feet and a half above water; their length is from fifteen to fifty feet; the two extremities are square, upon one of which is a kind of awning, under which the passengers shelter themselves when it rains.⁴

The flatboat was first used on the Ohio River before the end of the Revolution, and during the decade after the Revolution it became the favorite vessel of the immigrants. Pioneers crossed the mountains to the Upper Ohio Valley and purchased or built flatboats to continue the journey to their new homesteads. The watercraft used by the Indians were too unstable and limited in capacity to transport a family and their possessions; the ribbed and planked bateau of the French was relatively complex of construction; hence, the flatboat was evolved to meet the need for a large, stable vessel of simple construction. In addition to economic transportation, flatboats were also useful at the end of the voyage, for their lumber could be used in constructing new homes. The business of constructing these vessels for sale to the tide of immigrants reached major proportions in the Upper Ohio Valley in the late eighteenth century. Two to three hundred families annually embarked on the Monongahela at Brownsville for the down river trip, and there is record of 1200 immigrants boarding flatboats at Olean, New York, after the ice broke in 1815 to descend the Allegheny and Ohio rivers to new homes in the Lower Ohio Basin. In 1788, the peak

FLATBOAT
USED FOR BOATING COAL
ON
ELK FORK of LICKING RIVER.



Isometrical View



year of the great immigration, at least 308 flatboats, transporting over 6,000 immigrants, about 3,000 head of livestock, and 150 wagons passed down the Ohio on the spring rise.⁵

Flatboats depended on the current for motive power, and there was no turning back once embarked, for upstream navigation in such unwieldy craft required efforts which almost exceeded human capability. They were steered with long oars, or sweeps, but keeping in the unimproved, constantly changing river channel was quite a challenge. Boats often grounded on bars, wrecked on projecting rocks, or were pierced by snags, and in the early days of the traffic the threat of Indian attack was always present. Captain William Tell Poussin, a Frenchman who became an officer in the United States Topographical Engineers, traveled the Ohio River in flatboats on various missions before 1825. He later recalled:

In descending the Ohio and the Mississippi . . . it was customary to purchase and freight a flat boat. Embarking on this, it was necessary to trust to the strength of the current to convey you to your destination. This was certainly not a very expeditious method of traveling, especially when your only resource besides the current was the occasional use of the oar or the sail. From sixty to seventy days were consumed in this part of the journey; and it was not without exposure to difficulties and perils of no ordinary kind that so protracted a journey could be performed in the midst of the numerous Indians who, allured by the hope of booty, at that time frequented the shores of these rivers.

We arrived at New Orleans (from Pittsburgh in 1817), after this manner, in about eighty-four days, at an expense of from one hundred and twenty to one hundred and forty dollars; and the traveler who reached his destination with no other inconveniences than that inseparable from so hazardous an undertaking was considered exceedingly fortunate.⁶

Flatboats and Commerce

The exportation of commodities from

the Ohio Valley to New Orleans via the waterways began before the Revolution. As early as 1763, eighty thousand dollars worth of animal skins and tallow valued at four thousand dollars arrived at New Orleans from up river, and part doubtless came from the Ohio Valley where French and Spanish hunters were operating. It will be recalled that Baynton, Wharton, and Morgan of Philadelphia entered the Indian trade and army supply business on the Ohio in 1765; other similar mercantile firms were also active at about the same time. During the course of the Revolution there was also some limited traffic, both up and down the Ohio, in munitions and military supplies for the forces commanded by George Rogers Clark and other military units in the Ohio Valley.⁷

Jacob Yoder of Pennsylvania, and later Spencer County, Kentucky, has been credited with performing the first flatboat trip down the Ohio and Mississippi to sell agricultural produce at New Orleans in May, 1782. This may be true, but there exists fuller evidence for the trip of the Tardiveau brothers. At the encouragement of Benjamin Franklin and perhaps Jonathan Williams, Barthélemi and Pierre Tardiveau moved from France to Philadelphia in 1777 to establish a mercantile firm in partnership with Jean Holker, the first French Consul to the United States. In 1781 Tardiveau and Holker furnished supplies in the Ohio Valley for George Rogers Clark and the Virginia regiments, and in 1782 the firm sent a fleet of boats laden with flour and other merchandise from Fort Pitt to New Orleans; but they lost their investment when "pirates," a band of Loyalists and Indians led by James Colbert, seized the boats before they reached New Orleans.⁸

In 1783, Barthélemi Tardiveau conducted what might be called the first "in-

dustrial survey" of the Ohio Valley to explore the possibilities of establishing a regular trade from Kentucky to New Orleans. He addressed a questionnaire about business prospects to several leaders of the Kentucky settlements. Walker Daniel, the first Attorney General for the District of Kentucky, responded that a profitable trade could probably be had by constructing boats which could be sold along with their cargoes at New Orleans. Captain John May, the frontiersman for whom Maysville, Kentucky, is named, replied that Kentucky "hitherto had no commercial intercourse with any country whatever" and was in great need of merchants and trading facilities.⁹

Captain May believed that when hostilities with the Indians ended, the commerce of Kentucky would be great; salable commodities would include tobacco, flax, meat and animal products, grain, flour, and hemp. He listed a number of minerals which might be mined and manufactured, and mentioned that he had discovered a spring from which a substance resembling tar (petroleum) emanated. Captain May recognized the waterways route to New Orleans was longer than other possible trading routes, but explained: "it is not the distance, but the having water carriage that makes the expence of transportation light." The frontiersman also expressed an interesting opinion about the future of Louisville:

As the Falls of Ohio is the place where all vessels both coming up, and going down the river, must call to unload, when it is not very high; and as this place has a large extent of fertile country to support it; larger and richer than any other place in the united states [*sic*], I am of opinion it will be one of the greatest trading towns in America: Loaded boats can at all times pass up and down the river both above and below the Falls, but as it is only at certain periods that they can pass through, I am inclined to think that the vessels

intended for the navigation of the river above that place will be kept above altogether; that they will unload there, take in other cargoes, and return to the places from whence they sailed, without going below, and that other vessels will bring our goods to the Falls.¹⁰

Captain May's opinion about the future of the Falls of the Ohio area may have had some influence on the firm of Tardiveau and Holker, for it purchased large quantities of land on the Indiana bank of the Falls from soldiers of the Clark expedition. The firm also invested in lands (in present Gallatin County, Illinois) on the Saline River, a tributary of the Ohio, and established a salt-producing business.¹¹

A major obstacle to the trade with New Orleans was the possession of the port by Spain, which made the Ohio-Mississippi trade dependent upon the diplomatic relations between Spain and the United States. Trade with New Orleans was closed for a time in the mid-1780s, and was reopened by James Wilkinson, later a General of the United States Army and always a controversial figure on the American frontier. Wilkinson took a cargo of Kentucky produce to New Orleans in 1787 and negotiated the privilege of making further sales at that market. In 1788 he dispatched a fleet of twenty-five boats loaded chiefly with tobacco and flour from Kentucky to New Orleans.¹²

Spanish authorities opened the trade to other individuals; and after 1795 the flatboat trade reached major proportions. In 1798 goods valued at near a million dollars arrived at the "Crescent City" from the Ohio Valley. After the Louisiana Purchase of 1803, which secured American control of the port, the trade greatly expanded and in 1807 about 2,000 boats arrived at New Orleans from up river, bearing commodities valued at more than five million dollars. The variety of the articles sent

south from the Ohio Valley was indicated by the lading of 197 flatboats and 14 other vessels which descended the Falls of the Ohio in a two month period in the winter of 1810-1811. They carried pork, flour, whiskey, apples, cider, wines, brandies, vegetables, beef, cheese, rope and bagging, chickens, horses, lumber, slaves, pottery, iron manufactures, cabinetwork, and leather goods.¹³

Effect of Flatboat Trade at Louisville

As Captain John May predicted in 1783, the necessity for boats to land and hire a pilot or portage freight around the Falls of the Ohio made Louisville a mercantile center at an early date. The settlement at the Falls of the Ohio was founded during the Revolution by George Rogers Clark, a detachment of troops, and a handful of families, who descended the Ohio in flatboats. At the present site of Louisville and on an island at the Falls, Clark established a settlement and constructed a fort; the forerunners, it has been said, of Jeffersonville Quartermaster Depot and Fort Knox. Clark and his troops then proceeded down the Ohio to complete one of the most successful military expeditions in American history, capturing British posts in the Old Northwest in spite of floods, supply shortages, and the numerical superiority of the enemy's forces.¹⁴

The Falls of the Ohio and the natural harbor formed by the juncture of Beargrass Creek with the Ohio just above the Falls made Louisville a natural mercantile city. Scores of teamsters operated drays to move cargoes around the Falls, and a number of pilots made their livelihood by guiding boats across the Falls. The Dominion of Virginia established a customs collection station at Louisville in 1784; and one of the first acts of Congress was to make Louisville a port of entry for

the collections of customs duties in 1789. Other ports of entry established in the lower Ohio River Basin before 1800 included Palmyra, Tennessee, on the Cumberland River in 1797, and Cincinnati, Ohio, and Fort Massac, Illinois, in 1799.¹⁵ Waterways commerce was the single most important factor in the economic development of Louisville until about 1820 when manufacturing began its extensive development in the area; waterborne commerce was to remain an important element of the Falls City's economic structure throughout the nineteenth and twentieth centuries.

Shipbuilding

Ports of entry for the collection of duties on foreign trade were required in the Ohio Valley because New Orleans was in the possession of foreign nations until 1803. In addition, a number of full-rigged, sea-going sailing vessels were constructed at Ohio River ports in the last decade of the eighteenth century, freighted with Ohio Valley produce, and sent down the rivers to enter trade with the West Indies, Europe, and even to ports on the Mediterranean. Sailing ships were constructed at Pittsburgh, Marietta, Cincinnati, Louisville, and other inland ports in surprising numbers.¹⁶

One of the leading shipbuilding firms was founded at Pittsburgh in 1801 by Louis and John Tarascon and James Berthold. The Tarascons immigrated from France to the United States in 1794 and entered the importing and mercantile business at Philadelphia. In 1799, two clerks employed by the Tarascons, Charles Brugiere and James Berthold, navigated the Ohio and Mississippi rivers to survey the commercial prospects. After they made favorable report, the firm of John A. Tarascon, Brothers, James Berth-

old & Company was established at Pittsburgh and constructed a wholesale and retail store and warehouse, a shipyard, a rigging and sail loft, an anchor-smith shop, and all facilities necessary to build and equip sailing vessels. The company built and dispatched at least five brigs, schooners, and ships down the Ohio and Mississippi between 1802 and 1804. After entering the Gulf of Mexico, the vessels usually made Philadelphia their home port and entered foreign trade to ports as far away as Trieste, Italy.¹⁷

The company met with serious difficulties in getting its large vessels past the Falls of Ohio, and about 1806 relocated the business just below the Falls at Shippingport. But not long thereafter the shipping business was disrupted by the Embargo Act and the War of 1812; doubtless the advent of the steamboat on the Ohio in 1811 also made the enterprise less financially attractive. Shipbuilding was revived on the Ohio, however, in the 1840s, notably at Marietta, Ohio, and as late as 1865, a sea-going vessel, the *Mary Belle Roberts*, passed the Falls of Ohio on its way to foreign ports. Like the flatboat trade, ships constructed on the Ohio went down river and did not attempt the return. It appears that most did not raise their sails until the end of the voyage on the inland rivers.¹⁸

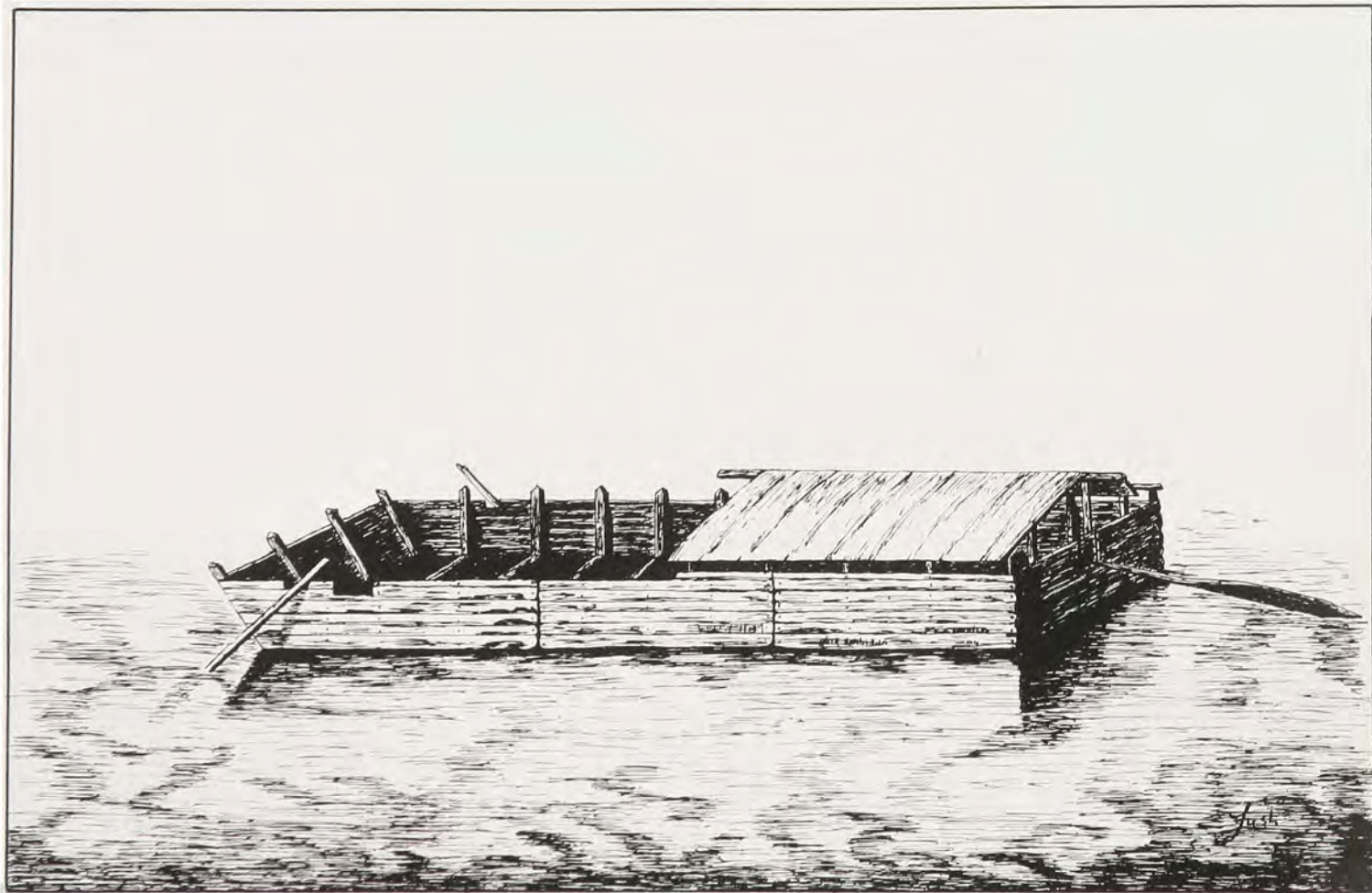
Keelboat Commerce

The problem of exporting Ohio Valley produce to market was solved by the flatboat, but importing goods was a more complex problem. Because transporting goods over the mountains from Atlantic ports by pack horse and wagon was quite expensive, the settlers of the Ohio Valley looked to the waterways as an economical alternative. Canoes, dugouts, and bateaux were used extensively for upstream

navigation in the earliest days of settlement, but they had limitations of cargo capacity which precluded their profitable utilization for long distances. Efforts were made to place flatboats in the upstream trade, but their box-like construction made the process so difficult and time-consuming that the cost was prohibitive. The first pioneer solution to the problem were the more maneuverable and greater capacity keelboats and barges.¹⁹

Keelboats and barges evolved from improvements in the construction of the bateau. The "keel" was the rigid longitudinal timber which bore the brunt of collisions, and the hull, shaped much like that of a sailing ship, was constructed of ribs covered with planking. The dimensions of keelboats varied from thirty to seventy-five feet in length and from five to ten feet wide, with a cargo capacity of from fifteen to forty tons — barges could be much larger. One keelboat navigator described the superstructure as "a covered way, a kind of cabin occupying the entire hold of the boat, excepting spaces for small decks at each end, and a strip on each side the whole length of the boat, about fifteen inches wide, called the 'run,' on which the men walked when 'poling' the boat upstream."²⁰

Keelboats carried masts and sails and used them when possible, but the boats were commonly propelled by a crew of men with long, iron-tipped poles. Standing at the prow of the boat, the crew rammed the poles into the streambed, braced them against their shoulders, and walked the boat upstream under their feet. At the stern, they picked up the poles and returned to the prow to repeat the process. Keelboats ordinarily ran close to a bank to avoid swift currents, and this often provided opportunity for "bush-



Sketch of a Flat bottom Boat; such as are used to descend the Ohio and the Mississippi.

VICTOR COLLOT, "A JOURNEY IN NORTH AMERICA IN 1796,"

whacking," or pulling the branches of overhanging trees to drag the boat up river. Where the current was swiftest, keelboatmen resorted to "cordelling" and "warping." The former consisted of putting the crew ashore to pull a rope attached to the bow or mast, and the latter involved tying the rope to an upstream tree and pulling from the deck of the boat.²¹

Like many early developments in Ohio River navigation, the date of the first use of the keelboat is in doubt. General James Wilkinson claimed in 1805 that he had accomplished the first voyage from New Orleans to Kentucky in 1789, but it is not clear that he used a keelboat. He described the vessel only as a "boat of fifteen tons burthen." Wilkinson observed that:

The existing impediments are sufficient to frighten cursory observers, and to condemn the idea of a familiar, convenient and profitable communication from New-Orleans to Louisville by water. A voyage of two thousand miles, with the same boat and crew, against a heavy current, appears sufficient to exhaust the strongest physical force, and to appal the most ardent enterprise; delays and extraordinary expences are inseparable . . .²²

Regular use of keelboats began in the 1790s, and by the time the first steamboat appeared on the Ohio in 1811 over three hundred keelboats were plying the Ohio and its tributaries and they had supplanted much of the over-mountain trade from the East. A keelboat owner reported in 1817 that the cost of operating a boat of thirty-six tons capacity from New Orleans to Louisville was \$1750, including \$75 salary to each member of a fourteen-man crew, subsistence for the crew for seventy-five days at \$525, pay for the steersman — \$75, and boat depreciation — \$100. He grossed \$3240 at a rate of \$90 per ton, which, minus his expenses,

equaled a profit of \$1490 for each trip. His capital investment was \$2,000 or less.²³

The Rugged Rivermen

Navigating the inland rivers in flats and keels was an extremely rough and dangerous business. In addition to the hazards of normal navigation on unimproved rivers, there were, in the earliest days, numerous Indian attacks on passing boats; later, there were the notorious pirates at Cave-in-Rock and the infamous boatwreckers at Fort Massac. Robbers victimized rivermen at all port cities and renegades infested the Natchez Trace, the overland return route to the Ohio Valley from New Orleans.²⁴

The rough life and manners of pioneer boatmen brought them a reputation, apparently well-deserved, for violence and profanity. Travelers were advised that rivermen were "incorrigible scoundrels," and that it would be wise to wear a dagger and a brace of pistols. A traveler on the Ohio in 1817 commented:

There are about two thousand people regularly employed as boatmen on the Ohio, and they are proverbially ferocious and abandoned in their habits, though with many exceptions . . . People who settle along the line of this grand navigation generally possess or acquire similar habits; and thus profligacy of manners seems inseparable from the population on the banks of these great rivers. It is remarked, indeed, everywhere, that inland navigators are worse than sailors.²⁵

Profanity was their native language; violence was a way of life. But pushing and pulling a boat up the Mississippi and Ohio rivers for \$75 a trip was the sort of life which encouraged gentility? The physical exertions required to push loaded boats up such snag-studded streams as the Salt River, which joins the Ohio a few miles below Louisville, were enormous, but it was done. Mike Fink, the Bunyanesque

hero of the keelboatmen, often boasted that he was a "Salt River roarer," and the difficulties encountered in navigating the Salt were imbedded in the English language in the imperishable phrase: "Up Salt Creek with a paddle." But navigating the rivers in the natural condition had its compensations, for those who had the time to appreciate them. John James Audubon, the naturalist, alluded to one of them in his description of a voyage from Louisville to Henderson, Kentucky:

It was in the month of October. The autumnal tints already decorated the shores of that queen of rivers, the Ohio. Every tree was hung with long and flowing festoons of different species of vines, many loaded with clustered fruits of varied brilliancy, their rich bronzed carmine mingling beautifully with the yellow foliage, which now predominated over the yet green leaves reflecting more lively tints from the clear stream than ever landscape painter portrayed or poet imagined.²⁶

Keelboat and flatboat pilots and crews did not lose their employment after the development of the western steamboat; indeed, the business increased for flatboat navigators because they no longer had to walk back to their homes. Keelboats lost the passenger traffic to the steamboats and could no longer compete on the long distance routes, but they found employment on tributary streams above the head of steamboat navigation until roads and railroads facilitated overland travel in those regions. Flatboat traffic did not reach its peak until fiscal year 1846-1847. In that year 2,792 flatboats arrived at New Orleans, and more than 2,200 were from the Ohio Valley. Use of the flatboat dwindled on the Ohio River after the Civil War, but some flatboat traffic continued until the early twentieth century.²⁷

Early Steamboat Navigation on the Ohio

From 1811, when the first steamboat on the Ohio frightened Louisvillians, until 1935, when the last commercially-operated sidewheel packet passed Louisville for the final time, residents of the Falls of Ohio area were participants and witnesses in the greatest development of steam navigation in history. The steamboat was the chief technological innovation in the United States in the early nineteenth century, and it launched a revolution in transportation which transformed the Ohio Valley from an isolated frontier region into a commercially developed and integrated section of the United States. Where keelboats took up to four months to push from New Orleans to Louisville, the first steamboat which made the trip cut the time to less than a month, and steamboats eventually made the run in five days. In addition to contributing to the commercial and industrial development of the Ohio Valley as a whole, the steamboat also was a major factor in the realignment of trade routes within the valley. For example, Louisville at its strategic location at the Falls of Ohio surpassed inland Lexington in population and as a trading center not long after the advent of the steamboat.²⁸

Like most technological advances, the development of the complex mechanism of the steamboat engine, the steamboat propulsion system, and the sophisticated design of the steamboat hull was a lengthy process in which many inventors and engineers participated. Though Robert Fulton has often been credited with the construction and operation of the first successful steamboat in the United States, that claim has been disputed on behalf of a number of other early marine engineers. Three men who resided in Kentucky for at least a portion of

their lives — John Fitch, James Rumsey, and Edward West — invented and constructed steam-powered, mechanically operated vessels, and each has had supporters in the dispute over who invented the steamboat.²⁹

Two Army Engineers, George Washington and Thomas Hutchins, early recognized the potential value of steamboats for river navigation and were interested in the work of John Fitch and James Rumsey. Thomas Hutchins introduced Fitch to the French Consul and brought Fitch's steamboat to the attention of Congress in efforts to obtain financial support for the further development of the invention. George Washington observed the operation of a model of the boat invented by James Rumsey, and wrote in 1784 that Rumsey "has discovered the Art of working boats by Mechanism and small manual assistance against rapid current; that the discovery is of vast importance, may be of the greatest usefulness in our inland navigation"³⁰

Edward West, who invented a machine for nail production and who has been acclaimed as the "father of the nail industry," demonstrated a model of his steamboat at Lexington, Kentucky, in 1793; but the first full-size steamboat which actually operated in the Ohio Valley was the *New Orleans*. It was constructed at Pittsburgh by Nicholas Roosevelt, who represented the Fulton interests. Roosevelt navigated from Pittsburgh to New Orleans in 1809 to study the rivers, collect commercial information, and arrange fuel supplies. He returned to Pittsburgh, constructed the steamboat *New Orleans*, and departed for New Orleans in October, 1811. The vessel reached Louisville near midnight on October 28, and the roar of escaping steam

brought crowds of Louisvillians to the riverside. Some thought a comet had fallen into the Ohio. But the Falls of Ohio were impassable at the time, and Roosevelt took the *New Orleans* back to Cincinnati where it waited until the end of November when the fall rise began. It returned to Louisville, crossed the Falls successfully, and steamed down river to enter the New Orleans-Natchez trade.³¹

Robert Fulton and his associates planned to operate three separate steamboat routes: New Orleans to Natchez; Natchez to Louisville; and Louisville to Pittsburgh. They also hoped to acquire a monopoly on the steamboat business in the West by acquiring exclusive charters from state governments. Fulton boats were placed in operation on each of the three routes, but the efforts of the company to secure exclusive rights to steam navigation were frustrated by competing firms who constructed their own boats, made free navigation an issue in the courts, and won a decision to the effect that states did not control navigable streams and could not grant exclusive privileges.³²

Captain Shreve and Early Steamboating

One of the rivermen who had a part in breaking the Fulton monopoly and who played a major role in the development of steamboat navigation on the Ohio and other inland rivers was Captain Henry Miller Shreve. Captain Shreve, whose home was Shippingport just below the Falls of the Ohio, began his career as a keelboatman; from 1813 to 1826 he was the foremost steamboat captain on the inland rivers, and from 1826 to 1841 he served as Superintendent of Western River Improvements for the Corps of Engineers. Henry McMurtrie, an early his-

torian of Louisville, wrote of Shreve in 1819: "It is to his exertions, his example, and let me add, to his integrity and patriotic purity of principle, that it [Louisville] is indebted for the present flourishing state of its navigation."³³

In 1814 Captain Shreve piloted the steamboat *Enterprize*, with a cargo of munitions, from Pittsburgh to New Orleans, arriving in time to participate in the Battle of New Orleans. He brought the *Enterprize* back to Louisville in 1815 — the first ever to make the upstream trip. The Fulton interests brought suit against the *Enterprize* and its owners for violating the exclusive privilege granted to the Fulton company by Louisiana, and it was reported that Captain Shreve was offered an interest in the Fulton company if he would deliberately lose the case but Shreve preemptorily refused the offer. In 1816 Shreve and his associates constructed the steamboat *Washington*, with an engine and machinery modified by Captain Shreve to reflect the results of his experience. The cylinder of the Shreve engine was nearly horizontal and was connected with the paddlewheel by a pitman. With few exceptions, the system used on the *Washington* was the basic design for western steamboats thereafter.³⁴

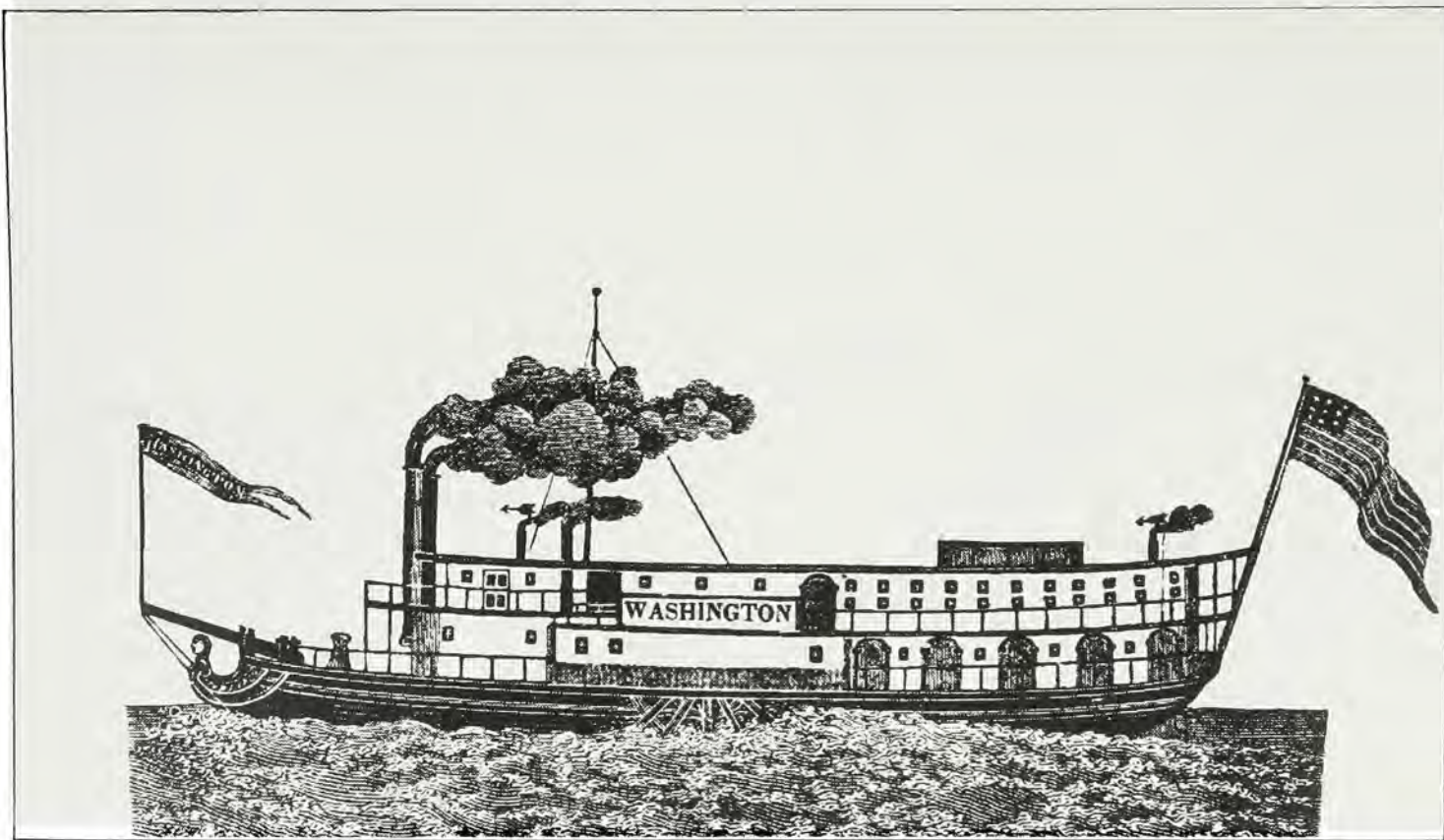
The maiden voyage of the *Washington* was not auspicious, however. It blew a cylinder head, or perhaps a boiler, near Maysville, Kentucky, killing thirteen of the crew. After repairs, the boat continued its voyage only to lodge on a bar above Louisville and spend the entire summer of 1816 waiting for a rise. Captain Shreve persevered, completed the trip to New Orleans, and subsequently made several highly profitable voyages in the *Washington* which engendered great interest in the potential of steamboat navigation.³⁵

Major Long and the Western Engineer

Further advances in steamboat construction were engineered by Major Stephen H. Long, Topographical Engineers, in 1819. Major Long, a Dartmouth graduate who had joined the Corps during the War of 1812, traveled the Ohio River in a skiff in 1816. In 1818 he was directed by Secretary of War John C. Calhoun to lead a combined military reconnaissance and scientific expedition, in conjunction with troops ordered to the frontier, down the Ohio and up the Mississippi and Missouri rivers. Of the four steamboats constructed for the expedition, three were built on the Kentucky River by James Johnson, an army contractor, and the fourth by Major Long at Pittsburgh.³⁶

Major Long made several novel modifications in the design of the steamboat, which he named the *Western Engineer*. He invented and applied the cam cutoff, a device which permitted a more economical utilization of available steam. Because he expected to navigate narrow and shallow rivers, he designed the hull and distributed the machinery in such a manner that draft of the boat was nineteen inches. The *Western Engineer* was seventy-five feet long and thirteen-feet abeam; the narrow width made possible by locating the paddlewheel at the stern of the boat, rather than at the usual position amidship. These modifications were significant contributions to the development of the western river steamboat.³⁷

There were a number of other unusual features in the design of the *Western Engineer* and its equipment. Major Long expected to encounter hostile Indian tribes during the expedition, and the boat was well armed to meet such a contingency; in addition, the vessel was de-



THE "WASHINGTON," BUILT 1820, AT CINCINNATI BY
GENERAL PAUL ANDERSON AND OTHERS

From an early woodcut in the possession of Frederick Way, Jr. Features:
Bob tail, crude paddle wheels, and absence of pilot house.

signed to win the awe and friendship of the natives. It flew a flag painted by Titian Ramsey Peale, a noted artist who accompanied the expedition, which represented a white man and an Indian shaking hands, bordered by a peace calumet and a sword. The engine and propulsion apparatus were completely concealed, and a steam-escape pipe was installed to emit smoke and steam through the head of a serpent, with a red, forked tongue, which projected from the bow. Thus, the *Western Engineer* might give the appearance to a native of a monstrous, black, fire-breathing serpent, which lashed the water to a foam with its tail.³⁸

Major Long launched the *Western Engineer* at Pittsburgh in the spring of 1819. It had a six-man crew, and nine enlisted men of the Corps of Artillery were also aboard to service the guns if necessary. Because it was a scientific mission, Major Long recruited several outstanding scientists and naturalists, including Dr. Edwin James, Titian Ramsey Peale, and Thomas Say, and he had two military assistants — Captain John R. Bell, Corps of Artillery, and Lieutenant William H. Swift, Topographical Engineers. The *Western Engineer* embarked from Pittsburgh, in company with ten keelboats carrying the Sixth United States Infantry, and arrived at Louisville on May 19, successfully crossing the Falls on May 20. At Shawneetown, near the mouth of the Wabash, Major Long made further modifications in the vessel, then proceeded to St. Louis and up the Missouri River.³⁹

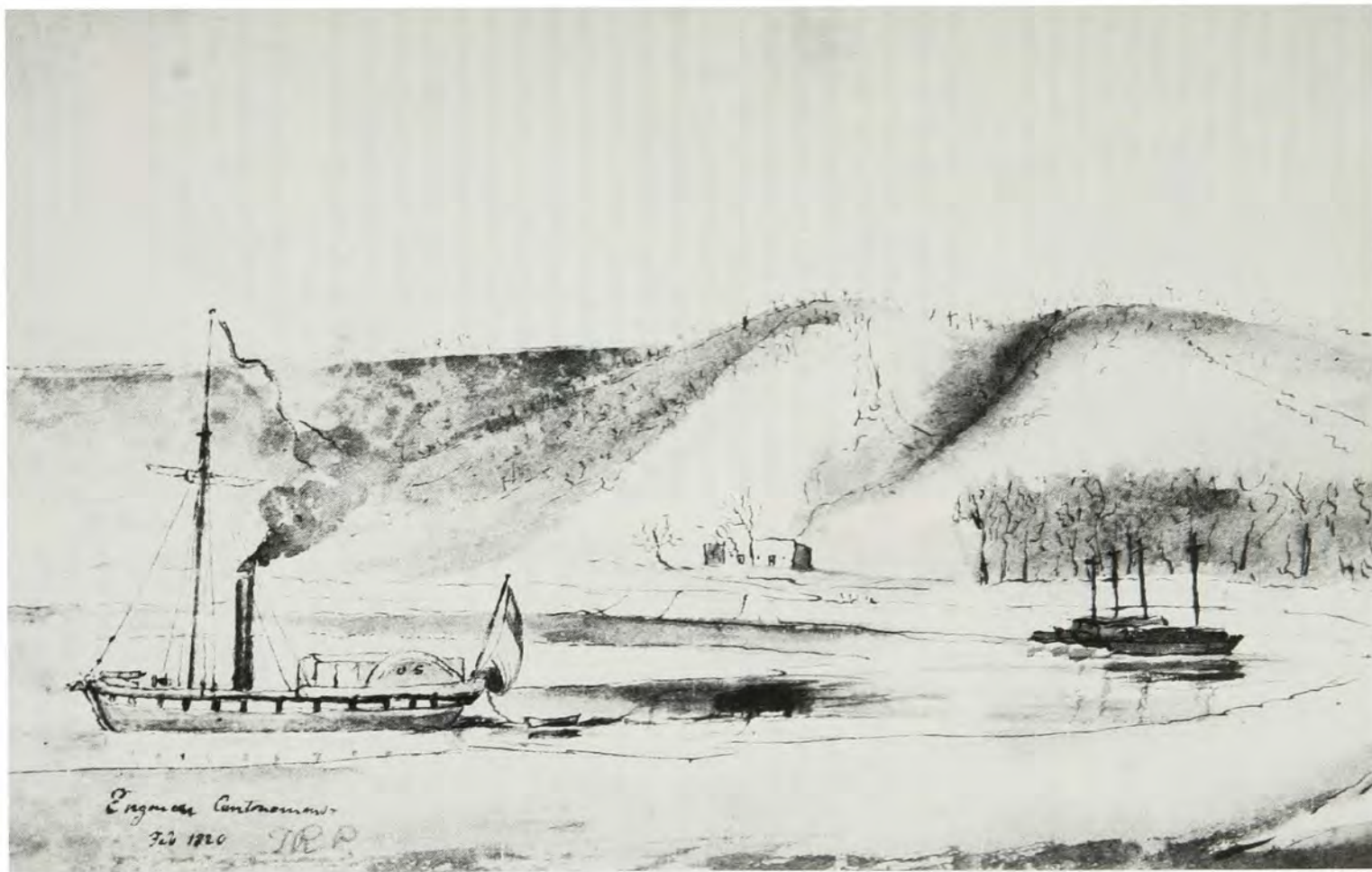
Accounts of the Long expedition of 1819 usually emphasize its consequences in the opening of the West to settlement and its contributions to topographic and scientific knowledge about the Missouri Valley frontier, for the *Western Engineer* was only the second steamboat to navigate the

Missouri and it went much farther up river than had the first. But, though the Ohio Valley was already settled, the Long expedition conducted scientific studies of fossil remains, minerals and vegetation, agricultural and timber resources, and waterways navigation during the voyage down the Ohio. Major Long personally reported on the navigation problems of the Ohio. He wrote:

The obstructions to its navigation are sand-bars, some few rafts, snags and rapids, to which the intricacy [*sic*] of its channel in several places, may be added. During a middle and high stage of water the obstructions entirely disappear, and an accelerated current is the only difficulty to be encountered. The average velocity of the current in a moderate stage of water may be estimated at 2½ miles, and in a high stage at 3 miles per hour. The season in which the navigation of the Ohio can be relied on commences between the middle of February and the first of March, and continues to the latter part of June. A Fall freshet usually takes place in October or November and the river is again navigable for a few weeks.

During the rest of the year boats of inconsiderable burden meet with numerous obstructions, in their progress, from the lowness of the water, and in many places no channel can be found of sufficient depth to admit their passage. At the distance of about 17 miles from its mouth, is the first serious obstruction to its navigation, consisting of a limestone bar extending across the river, denominated the Big [Grand] Chain. Three miles above it is another bar of similar description [Little Chain] The falls of the Ohio at Louisville are impassable for boats of burthen, except in the higher stages of the water. Le Tarts Falls and numerous other rapids denominated Ripples, are also impassable for boats of any considerable burthen, when the river is at its lowest stages. In this state the river is fordable in numerous places.⁴⁰

On his return from the exploration to the Rocky Mountains, Major Long planned to navigate up the Ohio River in the *Western Engineer*, but he found the Ohio too low for even a boat of nineteen-inches draft. During late 1819 and early 1820, there



(Painting by T. R. Peale, American Philo. Society Library, Philadelphia, Pennsylvania)

The U. S. Western Engineer, constructed by Major Stephen H. Long at Pittsubrgh, 1818-1819. Used by Major Long for Yellowstone expedition 1819-1820 and by Corps of Engineers (Board of Internal Improvements) in survey of Lower Ohio and Mississippi in 1821.

was no fall or winter rise and the Ohio River was at its lowest water stage for a longer period than at any other time prior to the Civil War.⁴¹ This lengthy low-water season had such drastic effects on community and economic life in the Ohio Valley that state governments and Congress initiated a program to improve navigation on the Ohio. The report Major Long made on the navigation problems of the Ohio in 1819 doubtless influenced his selection by the Chief of Engineers in 1824 to supervise experiments with methods of improving navigation.

Louisville and the Steamboat Boom

Steamboats reduced transportation costs by as much as eighty percent on the Ohio River, and at those low rates their operation was still profitable. Keelboat rates from New Orleans to Louisville before 1820 were commonly \$5 per hundred pounds; in 1820 steamboats on the same run were transporting freight for \$1 per hundred pounds. Steamboat navigation up the Falls of Ohio was usually impossible for ten or more months of the year; boats landed at Shippingport and their cargo was hauled to a point above the Falls and reshipped. Steamboat freight from the upper Ohio Valley was also hauled around the Falls, except at the higher water stages; thus, the Falls severed Ohio River navigation in twain and made Louisville a major river terminal.⁴²

In 1806 six keelboats and two barges carried the entire trade of Louisville, but by 1819 there were, in addition to keelboats, about twenty-five steamboats with an aggregate cargo capacity of 6,500 tons running to and from Louisville. A minister who floated down the Ohio in a flatboat in 1816 and returned on a steamboat in 1826 commented during the latter voyage:

I had remarked, as soon as we began to pass the highlands on the Ohio, the wonderful change, which ten years had wrought in that region. The log-houses were gone, and replaced by houses of brick. The orchards, which were just planted when I descended the Ohio, had become thrifty trees of considerable size, and were now white with blossoms. Passing steam-boats, thriving villages, bustle and business had taken the place of the solitude and stillness of the same places at the former period. Louisville had grown to be a fine town. The ware-houses, the stores, the smell at the landing even, the ship-yards, all indicated the mercantile character, the great and growing importance of the place.⁴³

Steamboat construction and supply became a major industry at the Falls of the Ohio. An iron foundry and steam engine factory located at Louisville in 1817, and produced its first ten steam engines in 1818. Between 1820 and 1880 almost 6,000 steamboats were constructed in the Ohio and Mississippi valleys; 32 percent were constructed near Pittsburgh; 26 percent at Cincinnati; and 23 percent in the Louisville area. Other steamboat construction centers on the Lower Ohio included Madison, Jeffersonville, New Albany, and Evansville, Indiana, and Smithland and Paducah, Kentucky. Other industries also located in the Ohio Valley to take advantage of low transportation costs; for example, the Hope Distillery Company relocated in 1816 from New England to Louisville, where it could draw the grain trade of the Ohio, Kentucky, Scioto, and Miami river basins.⁴⁴

The unique splendor and power of the western river steamboat somehow represented the aggressive Western spirit. Perhaps Captain William Tell Poussin, Topographical Engineers, best described this relationship:

Nothing exhibits in so significant a manner the extent to which steam navigation is identified with the active genius of the people of the West, as the daily motion of the floating ark, known as the

steamboat of the West, which is three-decked and not infrequently carries twelve hundred passengers.....

The traveler, starting from Louisville, Kentucky, can arrive at New Orleans, a distance of nearly seventeen hundred miles, in three days. The ascending trip can be performed in from five to seven days. The rapidity of this traveling is somewhat startling. This is especially the case when two steamboats, coming in opposite directions, are seen to pass each other. A stranger cannot witness this scene without feeling of apprehension. But the cool and tranquil American, confiding in the skill of the helmsman, contemplates with interest and a species of vanity these two smoking points, which are scarcely in sight before they are far away in contrary directions. They indicate his genius and his power!⁴⁵

Summary

From canoes and dugouts to gaudy steamboat palaces, navigation on the waterways of the Ohio Valley underwent a major metamorphosis between 1783 and 1824. The serviceable Indian watercraft were used on the frontier, but their lack of capacity and stability precluded their effective use for the transportation of the pioneers and their produce down the waterways. The flatboat admirably met the needs of the pioneers for economical transportation and its use continued until the twentieth century. But the flatboat was too cumbersome for efficient use in upstream navigation, so pioneer rivermen developed and adopted the keelboat for use in the import trade. The low-cost

transportation provided by the steamboat was revolutionary in effect: the volume of waterborne commerce on Ohio Valley waterways rapidly increased; transportation became a specialized business separate from agricultural and retailing pursuits; and the frontier subsistence economy of the Ohio Valley was transformed into a thriving, commercial structure.

The contributions of Army Engineers to these developments in navigation were not major; neither were they insignificant. The numerous guides printed for the use of immigrants and rivermen were based on maps originally prepared by Army Engineers. Officers and men of the Army Engineers were on the frontiers exploring, mapping, studying resources, reporting on navigation, constructing fortifications, and joining in the fight to protect the pioneers from Indian and foreign threats. Steamboat engineering benefited immensely from the work of Captain Henry Shreve and Major Stephen Long; the experience of these men in river navigation prior to 1824 was later called upon by the Corps of Engineers as part of its program to improve waterways navigation. By 1824, the amount of waterborne commerce on the Ohio and Mississippi rivers was so great, the population it served so large, and the need for navigation improvement so apparent, that federal action was initiated.

CHAPTER III: FIRST OHIO RIVER NAVIGATION IMPROVEMENTS

The extent of the powers of the government of the United States has been a controversial issue since the origins of the republic. The national debates over the constitutional questions involved have had lasting effects on the American political system, on the economic and social development of the republic, and on many other aspects of American life. The constitutionality of federally funded and supervised projects for internal improvement, or civil works, which encompassed the improvement of waterways navigation, was a political issue to which Congress devoted much of its time prior to the Civil War. Disagreement over constitutional issues prevented any improvement of navigation on American inland rivers until 1824, though a few seaport harbors were improved and federal funds were provided in a few instances for construction of road and canal projects. The consequences which this political controversy had for inland waterways navigation may be illustrated by the fact that between 1789 and 1861 more federal funds were appropriated for the construction of sea-coast lighthouses than for the improvement of navigation on the inland rivers.¹

During Congressional debates over constitutional issues, proponents of the improvement of waterways navigation sought to make a distinction between waterways projects and internal improvements in general, arguing that navigable waterways were under national rather than state jurisdiction. Opponents of internal improvements, on the other hand, were prone to include waterways projects as part of what they considered an unconstitutional program for internal improvements. In 1824 federal courts declared that navigable waterways were de-

finitely under federal jurisdiction, and the opposition to internal improvements and waterways improvement projects was temporarily overcome in Congress. As a result, an extensive system of federal aid to internal improvements — roads and canals — in conjunction with navigation improvement projects was initiated in 1824.

The Corps of Engineers organization was selected for the task of implementing the civil works program authorized by Congress in 1824, and this program included the first federal project for the improvement of navigation on the Ohio River. During the course of the first experiments with waterways improvement methods on the Ohio, the Corps of Engineers learned some important lessons which were to be of significant value to its subsequent projects for enhancing navigation on the inland rivers — lessons which were to have wide application throughout the United States.

Federal Civil Works Policies, 1789-1812

The first President of the United States was an ardent proponent of improved waterways navigation and of projects planned to unite the commerce of the Ohio Valley with that of the Atlantic states. George Washington wrote in 1786 that he was pleased by support for the improvement of inland navigation then prevailing. He declared: "No country is more capable of improvements in this way than our own, none which will be more benefited by them . . ."² Washington was personally active in a number of private and state projects for the improvement of navigation and transportation facilities; but the limited resources of private corpo-

rations and state governments prior to 1800 prevented the completion of many beneficial projects. The only projects of benefit to navigation undertaken by the federal government during the Washington administration were the installation of lighthouses, beacons, and buoys along the seacoasts. The same was true of the administration of John Adams, except that on the eve of the end of his term of office President Adams signed a bill which provided funds for the construction of public piers in the Delaware River at Philadelphia.³

During the administration of Thomas Jefferson, 1801-1809, public lands were granted to state governments to finance a few internal improvement projects, the construction of the National, or Cumberland, Road from Maryland to the Ohio Valley was authorized, and in 1807 Secretary of Treasury Albert Gallatin conducted a study of American transportation needs. In his report of 1808 to Congress, Secretary Gallatin declared the improvement of transportation in the United States was important for commercial reasons and also was vital to the defense of the nation and its territories. He recommended the construction, with twenty million dollars of federal funds, of a north-south canal and road system across the Atlantic states from Maine to Georgia and the development of four transportation routes across the Appalachian mountain chain into the Ohio Valley. But his report was completed shortly after foreign complications had led to the Embargo Act and Congress did not act upon it. Though Congressman Peter Porter of western New York state and Senator John Pope of Kentucky sponsored bills in 1810 which would have authorized construction of portions of transportation system outlined in the Gallatin Report, Congress did not enact them.⁴

The War of 1812 and Federal Waterways Policies

The events of the War of 1812 convinced many American political leaders that improved waterways and transportation facilities were necessary for the proper defense of the United States. The use of the inland rivers to transport troops and munitions from the Ohio Valley to defend New Orleans in 1815 provided proponents of improved waterways navigation with an eloquent argument for federal action. Inadequate transportation facilities had also contributed to the very high prices paid by the government for supplies and munitions furnished troops on the frontiers. A summary of these arguments were printed in an editorial in the *Louisville Public Advertiser* in 1822, which read in part:

The improvement of the Ohio, from this place to its junction with the Mississippi, is demanded, not only on account of its being the principal outlet for the produce of several flourishing states, but by national considerations. New Orleans must always look to the interior for a force competent and willing to defend her in the event of war. Hence, an armory at this point, and the removal of obstructions in the river below, are essential both to the public interest and the national safety.⁵

A Board of Fortifications, consisting of two Army Engineers and a naval officer, was appointed in 1816 to study the defense of the United States in the light of the experience of the War of 1812, and it reported that the proper defense of the nation rested on four pillars — a strong navy, adequate coastal fortifications, a regular army and organized militia, and improved transportation routes in the interior to permit rapid concentration of the armed forces. Captain William Tell Poussin, secretary to the Board of Fortifications, later explained the fourth recommendation: "While every improvement in the chan-

nels of communication has . . . a direct relation to the national defense, it especially tends to develop the agricultural industry of the country, the fundamental basis of public prosperity, and to consolidate the internal peace of the citizen."⁶

John C. Calhoun, who as a member of Congress in 1817 had engineered the enactment of a bill to initiate construction of projects recommended in the Gallatin Report of 1808 only to see it vetoed by President James Madison for constitutional reasons, became Secretary of War to President James Monroe. In response to a resolution of the House of April 4, 1818, Secretary Calhoun, with the aid of the Board of Fortifications, studied the question of transportation routes in the interior. He reported in 1819 that federal aid to transportation would have multiple civil and military benefits, for, he said; "It is in a state of war, when a nation is compelled to put all of its resources in men, money, skill, and devotion to country into requisition, that its Government realizes in its security the beneficial effects from a people made prosperous and happy by a wise direction of its resources in peace."⁷ The reasoning that the improvement of transportation facilities would have both civil and military benefits explains, in part, the assignment of the Corps of Engineers, United States Army, to the supervision of such improvement projects in 1824.

State Survey of the Upper Ohio

While Congress was debating the constitutional questions surrounding the issue of improved waterways and transportation facilities, the steamboat boom which began in the post-War of 1812 era in the Ohio Valley engendered such great support for the improvement of navigation on the Ohio River that state governments in the region took joint action without fed-

eral aid. The extended low-water seasons on the Ohio River in 1818, 1819, and 1820 had catastrophic effects on business affairs in the valley. Over three million dollars worth of merchandise and hundreds of travelers and immigrants were held up for months in 1818 at Ohio River ports while waiting for a rise in the river. There was no fall rise at all in 1819, and navigation on the Ohio was suspended from April, 1819, to February, 1820. A visitor to the Ohio Valley in 1819 mentioned about a hundred steamboats were on the river, but not one had been running for more than six months, with ruinous effects on both navigation interests and commerce in general.⁸

On January 27, 1817, the state of Ohio invited the states of Kentucky, Virginia, Indiana, and Pennsylvania to appoint representatives to a joint commission authorized to devise plans for the improvement of the Ohio River from Pittsburgh to Louisville. All except Indiana accepted, and the Joint Commission met at Pittsburgh on August 1, 1819, to begin its examination of the Upper Ohio River. Members of the Commission were Samuel Blackburn of Virginia, Edward Tupper of Ohio, Walter Lowrie of Pennsylvania; John Adair of Kentucky was the fourth member, but he did not join the survey party until it reached the Falls of the Ohio. The Commissioners appointed Magnus M. Murray as surveyor, purchased the necessary equipment, hired boatmen and laborers, and set off down the river. One hundred two maps of the worst obstructions on the river were made during the five-week survey. At Louisville, in early October, the Commission was met by a committee of citizens who furnished the Commission with studies and maps of the Falls of the Ohio; and at Gallipolis, Ohio, on November 2, 1819,

the Commission completed its report. The Commissioners did not believe any precise calculation of a benefit-cost ratio for the project of improving navigation on the Ohio River was necessary:

The Commissioners deem it superfluous to offer any arguments to show the advantages that would result from the improvement of the navigation of this noble stream. Were any wanted it would only be necessary to allude to the loss of property occasioned by the wreck of descending boats, to the painful spectacle of steamboats, barges and even vessels of less burden locked up for the want of a sufficient depth of water, many of them lying on the bars, none of them in a good state of preservation, and numbers going rapidly to decay, whilst through a fertile and populous region of 1000 miles in extent, the commerce and interchange of domestic commodities are completely embargoed.⁹

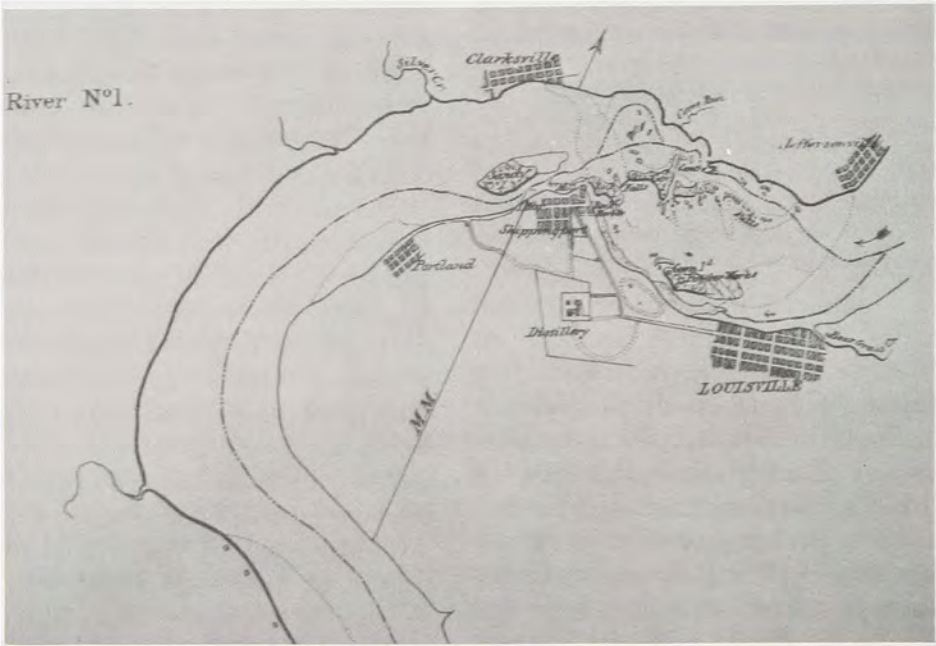
The Commission recommended the construction of a canal around the Falls of the Ohio along the Kentucky bank and the appropriation of ten thousand dollars by each of the four participating states for the general improvement of navigation on the Ohio. John Adair, shortly after completion of the survey and report, became Governor of Kentucky, and in a message to the Kentucky legislature in 1820 he urged the participation of the state in joint efforts to improve Ohio River navigation, arguing that the project could be completed in a season and that its expense would be more than repaid at every succeeding navigable stage. No action was taken by Kentucky, however, nor by Virginia and Ohio, except to appeal to Congress for federal improvement of the river. Pennsylvania, however, appropriated \$15,000 and in the early 1820s cleared the Ohio of the worst obstructions between Pittsburgh and Wheeling, the terminus of the National Road, to open navigation to keel and flatboat traffic at low-water stages.¹⁰

Federal Survey of the Lower Ohio

On April 14, 1820, Congress appropriated \$5,000 to continue the survey initiated by the states in 1819 of navigation problems on the Ohio and Mississippi rivers. The mission of completing the survey from Louisville to New Orleans was assigned by the President to the Board of Engineers for Fortifications; and in 1821 Captain Hugh Young, Topographical Engineers, boarded the U. S. Steamboat *Western Engineer* at Smithland, Kentucky, on the Lower Ohio and took it to Louisville. There, he was joined in early October by General Simon Bernard, Colonel Joseph G. Totten, Captain William Tell Poussin, and Lieutenant Stephen Tuttle. General Bernard had served as Engineer to Napoleon Bonaparte, had immigrated to the United States after Waterloo with a recommendation from Lafayette, and had been appointed Brigadier General in the Corps of Engineers; he returned to France in 1831 to become Chief of French Army Engineers and Minister of War. Colonel Totten served in the Corps from 1805 to 1864, twenty-six of those years as Chief Engineer of the Corps. Captain Poussin, whose travels in the Ohio Valley have been previously mentioned, also came to the United States from France and joined the Corps; like General Bernard, he returned to France and later became Ambassador to the United States from France and wrote several histories of the United States and its transportation system.¹¹

The Louisville *Public Advertiser* printed a lengthy editorial concerning the arrival of these officers at the Falls City and their mission, which read in part:

We are gratified that our two great western rivers, and the extensive and populous country through which they flow, have attracted the attention of the government. This survey is to be made



1821 Survey of Ohio River below the Falls of Louisville, Kentucky by the Corps of Engineers — General S. Bernard, Captain W. T. Poussin, Colonel J. Totten and others.

with a view to the improvement of their navigation, and we have now every reason to believe that, the west, if its representation unite on the subject, will soon feel the good effects resulting from at least a partial participation in the public expenditures.

The contemplated improvement of the two principal rivers in the west, so as to render them navigable at all seasons must be an undertaking of the first magnitude to the government and people. It will greatly facilitate the passage of our produce to market at the most important season of the year, while the government will be able at any time, in case of the future invasion of New Orleans, to send men, arms and ammunition in time to defend it. We view the proposed improvement, as one of far higher interest than that by which New-York is immortalizing herself [Eric Canal], as the whole population of the great valley between the Allegheny and Rocky Mountains will be benefitted by its consummation . . .¹²

The Board of Engineers departed Louisville on October 16 to perform the survey; they arrived at New Orleans at the end of the year, inspected harbors and seacoast fortifications along the Gulf of Mexico, and returned to headquarters to complete their reports and maps. The Board mapped the twenty-one worst obstructions to navigation on the Lower Ohio and recommended projects for their improvement. The methods suggested to accomplish the proposed improvements included a canal around the Falls of the Ohio, the removal of snags and projecting boulders, and the construction of experimental wing-dams, or longitudinal spur dikes, to contract the river channel at shoals. Their report became the basis for subsequent Congressional authorization in 1824 of a project for improving the Ohio.¹³

First "Rivers and Harbors Act," 1824

From 1815 to 1824, increased public support for the construction of roads and canals and the improvement of waterways was evident. Much of this support came from the Ohio Valley and the West, where

the need of a growing population for better transportation and marketing facilities was acute. Citizens of the Ohio Valley eagerly sought federal aid for the improvement of transportation, and, through their increased representation in Congress, made their wishes known. Westerners were especially bitter about the continued neglect of the improvement of inland rivers as compared with the continued funding provided for harbor improvements and lighthouse construction along the seacoasts. The editor of the Louisville *Public Advertiser* complained about this disparity in 1821:

If we ask the aid of the nation in removing an obstruction, to the navigation of a river, penetrating to the centre of the Union, and forming the only out-let to the produce of several powerful states, our supplications are to be treated with contempt; until our Atlantic shore presents a chain of battlements and towers — till every port, bay and in-let is ornamented with a light-house . . .¹⁴

One congressman described the Eighteenth Congress, 1823-1825, as constituting a "new era in our politics" because it represented millions of men from frontier states who had exercised their political rights for the first time. The Eighteenth Congress did give increased attention to the needs of the West, particularly to its transportation problems. Congressman Henry Clay of Kentucky, as Speaker of the House during the Eighteenth Congress, led the Western bloc in Congress in efforts to provide appropriations for internal and waterways improvement projects. He was strongly supported by Congressmen Robert P. Henry and Charles A. Wickliffe of Kentucky in the House, while in the Senate the proponents of federal civil works were led by Senator Richard M. Johnson of Kentucky.¹⁵

The opposition to the Clay "American System" came principally from eastern

states, whose representatives maintained that both federal aid to canal and road construction and federal improvement of inland river navigation were unconstitutional extensions of federal powers. Congressman Charles A. Wickliffe, in explaining to his constituents the nature of the controversy, claimed that the opposition believed, or pretended to believe, that federal aid to commerce was limited to the tidewater, that improvement of inland river navigation was a violation of state sovereignty.¹⁶

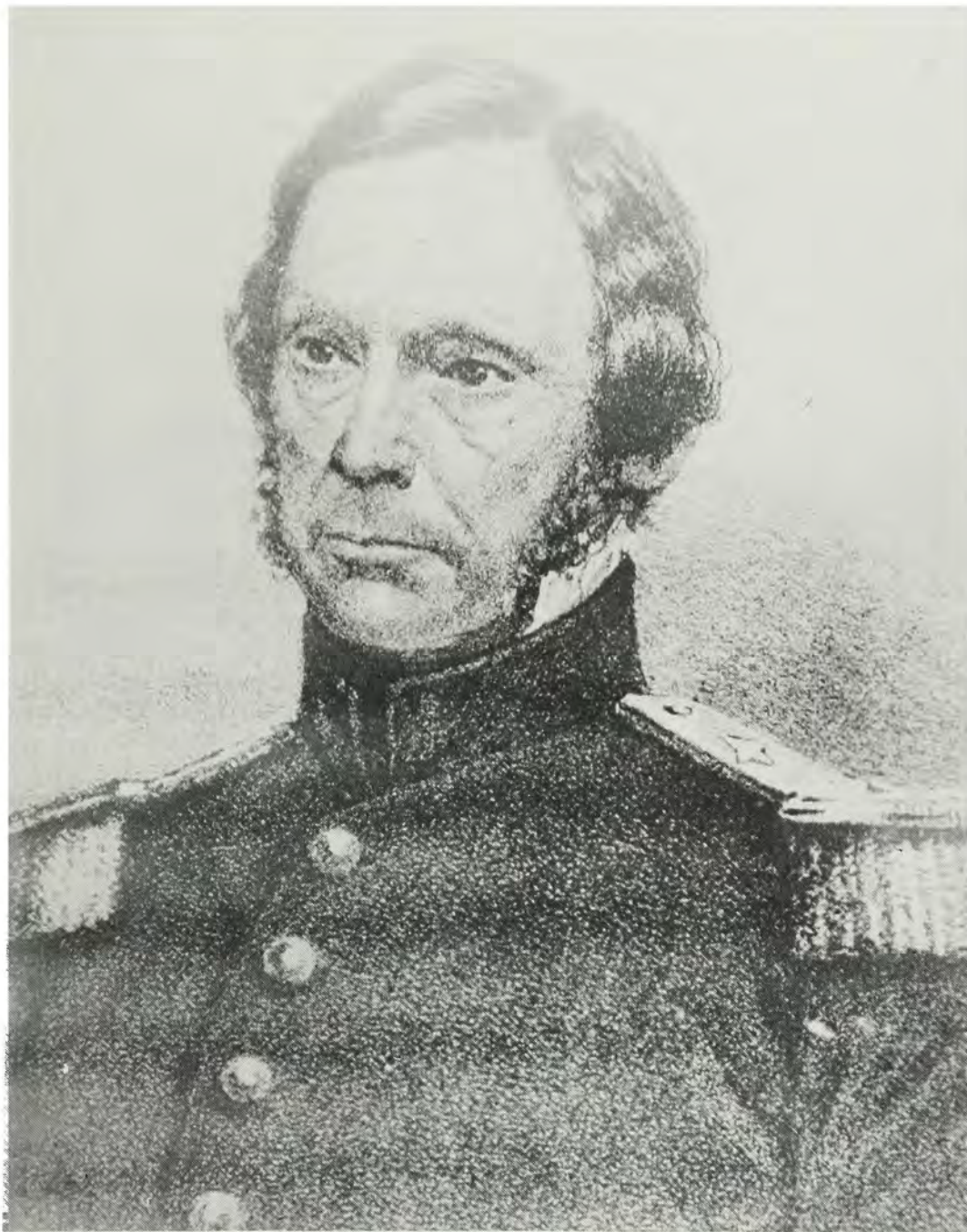
In the Congressional debates over the constitutionality of waterways improvements, Henry Clay often reminded the House that the report of the Board of Engineers demonstrated that improvement of navigation on the Ohio and Mississippi rivers was feasible, and he pointed out that the two rivers were the boundaries of several states, the "common commercial highway of all," and therefore were national property. The improvement of their navigation, Clay argued, should be a question of methods and expediency, not of constitutionality. Congressman Robert P. Henry told the House that if the work were not undertaken by the federal government, it would be undertaken jointly by a regional compact of the states; and he warned Congress that such a confederacy, devoted to the furtherance of its own special interests, might be a serious threat to the Union. These men prevailed in the Eighteenth Congress and their leadership led to the enactment of landmark legislation.¹⁷

On April 30, 1824, President James Monroe signed the General Survey Act, which authorized the President to assign Army Engineers to surveys of roads and canal which were important to national commerce, defense, and transportation of the mails. And on May 24, he signed the

first "Rivers and Harbors Act," which made an appropriation of \$75,000 for the improvement of the Ohio and Mississippi rivers. The Act listed six bars in the Ohio River below the Falls and directed that experiments be conducted to determine the best method of improvement at those localities; it directed "prompt and effectual" steps be taken to remove "planters, sawyers, or snags" which might, at the *lowest stage* of the water, endanger traffic on the Ohio and Mississippi rivers.¹⁸

Secretary of War John C. Calhoun urged that the Army Engineers be assigned to the work authorized by the General Survey Act and Rivers and Harbors Act of 1824, contending the work would keep the Engineers fit and trained for war in time of peace and secure greater efficiency in the construction of the projects. Henry Clay agreed with the Secretary and arranged the amendment of both acts to provide for the utilization of the services of the Army Engineers. To supervise and perform surveys under the General Survey Act, the Secretary of War appointed a Board of Internal Improvements, consisting of General Simon Bernard, Colonel Joseph Totten, and John L. Sullivan, a distinguished civil engineer, with Captain William Tell Poussin as recording secretary. This board functioned until 1831, performing scores of road and canal surveys and participating in the planning of the first railroads constructed in the United States.¹⁹

The implementation of the provisions of the Rivers and Harbors Act was assigned to General Alexander Macomb, Chief Engineer of the Army (1821-1828; appointed General-in-Chief of the Army in 1828). It will be recalled that General Macomb had navigated the Ohio in a flatboat with Major Jonathan Williams in 1801. General Macomb took two "prompt" measures to



(U. S. Signal Corps Photograph)

COLONEL STEPHEN H. LONG

meet the requirements of the Act: he initiated a search for an effective method of removing snags and he dispatched Major Stephen H. Long back to the Ohio Valley to conduct experiments with wing-dam, or dike construction.

First Federal Improvement of Ohio River Navigation

Major Long inspected the six bars in the Ohio River listed for improvement in the Rivers and Harbors Act during the summer of 1824, and he selected a gravel bar which had fifteen inches of water over it at low-water for his experiments with fluvial hydraulics. The bar was located near Henderson, Kentucky, a few miles below the mouth of the Green river and Evansville, Indiana. After extensive study of the bar, Major Long determined the best method of improvement would be to construct a wing-dam of timber piling extending from the right bank toward the river channel at a forty-five degree angle downstream. The purpose of the structure was to narrow the channel of the river, thereby increasing the volume and velocity of the water crossing the bar, and, hopefully, removing the bar through the scouring action of the river itself. Major Long employed Asa B. Shepherd, the first civilian assistant employed by the Corps of Engineers on the improvement of the inland rivers, as supervisor of a working crew, built a floating plant — mostly flatboats — constructed manually operated pile-driving machines which had five-hundred-pound weights as rams, mounted the pile-drivers on flatboats, and began the experiment.²⁰

During the low-water seasons of 1824 and 1825, Major Long experimented with various wooden-pile dam structures, trying different lengths, different widths, dif-

ferent heights. The dam, as finally completed, was 402 yards long and consisted of a double-line of 1400 wooden piles tied together with timber stringers and filled with brush. The cost of this wing-dam, the first improvement to navigation on the Ohio River constructed by the Corps of Engineers, totaled \$3,778.93, including all expenses. Major Long left Asa Shepherd at the site to make daily inspections of the structure. Shepherd later reported the dam fully met every expectation; it concentrated the river flow sufficiently to cut away the bar and increased the navigable depth over the bar to a minimum of four feet. Sand and gravel accumulated around the dam to such an extent that it served navigation for many years — it was still functioning in 1872 when it was repaired and extended.²¹ Until the construction of the slackwater system of locks and dams on the Ohio River, 1875-1929, this type of spur dike was the principal method used for increasing navigable depths on the Ohio. The method was still used where appropriate on the inland waterways in the mid-twentieth century.

Contest of 1824

The second major provision of the Rivers and Harbors Act of 1824 authorized the acquisition of the "watercraft, machinery, implements, and force" necessary to remove planters, sawyers, and snags from the Ohio and Mississippi rivers. "Snag" was the western rivermen's name for any timber obstruction to navigation, and a traveler on the Ohio in 1817 explained: "A *Planter* is a tree rooted fast to the bottom of the river, & rotted off level with the water, a heavy boat striking one of them may be staved and sunk. *Sawyers* are trees less firmly rooted; they rise and fall with the water; if they point up the stream, they are dangerous, but not so much when they



979, Aug. 20, 1892.

OHIO RIVER, Flint Island Dike.

383 miles from Pittsburg.

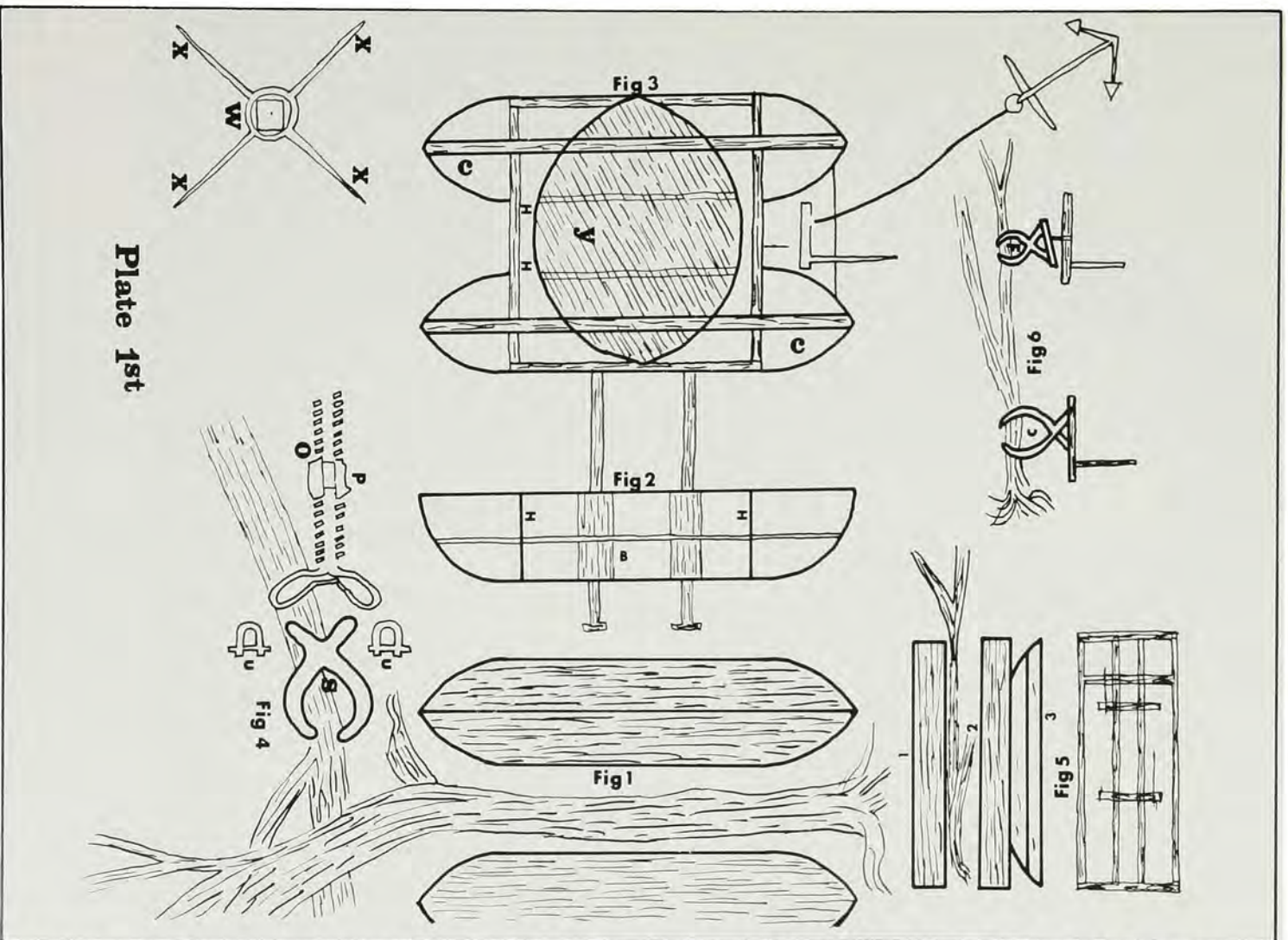
point down.” One riverman estimated in 1824 that the total number of snags in the Ohio and Mississippi rivers could not be less than 50,000, and he added: “if these were removed and kept so, the river would assume a new aspect, highly creditable to those engaged actively or passively, in the contemplated improvement.”²²

Water-soaked snags, often over a hundred feet long and weighing many tons, were deeply imbedded in the river bottoms. Where exposed at low water they could be sawed off and chopped down, but in the river channel this would leave a stump, more dangerous to traffic because pilots could not see it. A powerful mechanism to extract the entire snag was needed, but no such machine was known to exist in 1824. General McComb decided to solicit solutions to the problem from the public, and printed an advertisement in newspapers across the nation in June, 1824, offering a one thousand dollar prize for the best “plan, machine, or instrument” designed to remove snags. An avalanche of mail followed and men began to gather in the halls of the War Department carrying models of their machines and testimonies to their “respectable and worthy” character from their congressmen.²³

Some of the devices entered in the contest were ingenious, some promising, and some weird. Many were inspired by the twin-hulled, horse-powered, ferry-flat, a vessel common to the western rivers at that time. The ferry-flat was simply two boats spaced about ten feet apart, connected by heavy timbers, and planked over to permit the ferriage of large amounts of freight across rivers in one trip. They were often propelled by horses turning a capstan on the deck of the boat to

wind a rope tied to the opposite shore, or to turn a shaft geared to a paddlewheel mounted between the two hulls. Many entries suggested anchoring a ferry-flat below a snag, attaching a rope to the snag from the capstan, and then whipping the horses. One contest competitor asserted that horses were “preferable to Steam for they may be instantly checked if necessary.”²⁴

Some entries proposed utilization of the power of the river current to remove snags. For example, one suggested use of an “Impulse Boat,” simply a boat loaded with stone attached to a snag by a long slack chain; when the heavy boat, running with the current, reached the end of the chain it would jerk the snag out of the riverbed. Other entries suggested using floating wooden dams and a canvas device, similar to a parachute, which, when chained to a snag, would open in the river current and gradually tug the snag from its mooring. Some competitors suggested blasting snags out of the river with gunpowder, and they submitted plans of underwater devices for boring holes in snags, inserting canisters of gunpowder, and detonating the charges. And there were a number of machines designed for subaqueous sawing. John W. Parker, a millwright of Vincennes, Indiana, suggested sending two men to the bottom of the river in rigs which resembled deep-water diving suits to saw off snags with a crosscut saw. Several trained engineers, such as John L. Sullivan, Major Stephen H. Long, Captain Richard Delafield, submitted plans for using the power of steamboats to remove snags. These plans came very close to the steam-powered snagboat eventually invented by Captain Henry M. Shreve and constructed by the Corps of Engineers in 1829.²⁵



ENTRY OF JOHN W. PARKER IN CONTEST OF 1824 SNAG REMOVAL MACHINE. FROM NATIONAL ARCHIVES, RECORD GROUP 77. LRJ

The Contract of 1824

Because the Rivers and Harbors Act of 1824 called for "prompt" action to remove snags, the Chief Engineer placed an advertisement in the newspapers, running with the request for submission of proposed devices for snag-removal, which asked for bids from contractors for removing snags from the Ohio and Mississippi rivers. It requested that proposals for removing snags from the rivers at the *lowest stage* of the water be submitted by September 1, 1824. At least twelve bids were received, but the two which received serious consideration came from Samuel McKee and John Bruce of Kentucky. Samuel McKee, an attorney and former member of Congress from Lancaster, Kentucky, was well-known nationally as one of the pre-War of 1812 "Warhawks." He and his associates offered to clear the Ohio River of snags for \$25 per mile down to Shawneetown, \$30 per mile from Shawneetown to the mouth of the river, and bid \$30, \$81, and \$100 for various sections of the Mississippi.²⁶

John Bruce of Vanceburg (Lewis County), Kentucky, carrying with him plans of a snag-pulling machine, a proposal to contract for the removal of snags from the Ohio and Mississippi rivers, and recommendations from numerous political leaders of Kentucky, including Henry Clay, traveled to the War Department in person in August, 1824. He met with the Secretary of War and the Chief Engineer and proposed to clear the entire Ohio and the Mississippi from St. Louis to New Orleans of snags for sixty thousand dollars on the condition that he use his own "machine boat" for removing snags. The "machine-boat" was merely a ferry-flat with a windlass and various levers to multiply the power of manual operation. Because Bruce would use only his own

machine for removing snags, and it did appear to be a workable device, he was awarded the \$1000 prize when his bid for removing snags was accepted by the War Department on September 23, 1824.²⁷

The contract provided that for the sum of \$60,000, which was \$140,000 less than his nearest competitor, Bruce would remove all snags which impeded navigation in accordance with the Rivers and Harbors Act of 1824. He was to complete the work by January 1, 1827, and submit his work to the inspection of an officer of the Corps of Engineers. One disgruntled competitor commented the Bruce contract was a "leap in the dark" well calculated to "ruin the undertaker, or to impose on government," for no one really knew what the project would entail. Another predicted the contract would not accomplish its goals because "it will require the labour of each *succeeding season*, to repair the injuries done the navigation at each *preceeding* flood, or in other words it will require constant labour and attention . . ."²⁸

Major Samuel Babcock, Corps of Engineers, was selected to inspect performance of the Bruce contract. It was to prove an unfortunate choice; Major Babcock had no experience with river navigation, nor had he ever traveled the Ohio and Mississippi rivers. He supervised construction of Fort Delaware from 1815 to 1824, and had been court-martialed in 1824 for erroneous estimates and faulty construction of the works. The evidence submitted at the hearing proved he was guilty of no wrong-doing but did not indicate a high degree of competence. Only three months after acquittal in the Fort Delaware case, Major Babcock received orders, dated November 16, 1824, from the Chief Engineer to report to Pittsburgh to inspect the work of John Bruce. Babcock was warned that he would "be held



(Chief of Engineers Photograph)
(Record Group 77, National Archives)

MAJOR GENERAL ALEXANDER MACOMB

Chief, Engineer Corps, 1821-1828

responsible for the faithful execution of such parts of the work as may be comprehended in your certificates, as well as for the correctness of your estimates of the value of work done. The contract, which is presumed to be too clear to require explanation, will be your guide."²⁹

On arrival at Pittsburgh, Major Babcock found that John Bruce was constructing machine boats, collecting a work crew, and did not plan to initiate operations till June, 1825. Major Babcock requested a leave until that date, but it was refused. General Macomb explained that the "Western people look with great anxiety towards the accomplishment of the contract, and the Department feels great solicitude that nothing shall be wanting on its part towards carrying into effect the magnificent designs of Congress in this instance."³⁰

John Bruce assembled a floating plant of eight skiffs and flatboats and four machine boats and employed a crew of laborers; and on June 30, 1825, with eighteen months left on the contract, he began the project. Major Babcock wrote an extensive description of the Bruce machine boats:

Two [hulls], parallel to each other, and from eight to twelve feet apart, so as to embrace the largest trees; they are connected together by cross timbers, which support a lever of from fourteen to twenty feet in length, the fulcrum of which is two feet from the end; from this depends an iron bar, perforated at short distances; to that is attached a pair of iron claws, shaped like those of a crab. From the end of the lever a rope passes, which leads to a windlass worked by four men. The weight of the largest trees offers but a trifling resistance to this simple machine. To maintain the machine in its place, instead of iron anchors, four upright pieces of wood [spuds] are used which slide up and down in places made for them, at pleasure, at the opposite angles of the machines."³¹

With thirty-two men operating the machine boats and a small additional force

using hand tools, Bruce proposed to clear the entire course of the Ohio River and most of the Mississippi of all snags, estimated by one riverman to number about 50,000, in about eighteen months. Major Babcock drifted along behind the working boats in a large bateau rowed by four men to inspect the work as it progressed down river. Babcock observed that the contractor was removing snags from the low-water channel only and he requested instructions from headquarters. General Macomb replied:

It appears to me impossible to make the 1st Article of that contract, which embraces the points in question, more clear by any attempt at explanation which would be merely a repetition of the language in which that article is couched.

I must again refer you to the contract which admits of but one interpretation.³²

But the contract was subject to two interpretations. It directed that the work be done in accordance with the provisions of the Act of 1824, which clearly called for the removal of snags from the low-water channel, as had the printed advertisement which asked for bids on the work, while another phrase in the contract provided that all snags "which impede the navigation" will be removed. At high-water stages many more snags than at low-water impeded navigation, and rivermen commonly used different channels at high water than those they navigated at low water. John Bruce doubtless presented Major Babcock with copies of the Act of 1824 and the advertisement, for the Major accepted the *one* interpretation of the contractor.³³

The project was completed to Wheeling in a short time because Pennsylvania had cleared the low-water channel of that river section a few years before; Bruce was paid one thousand dollars for this first work. In September the work crews reached

Maysville, Kentucky, where a minor incident interrupted operations. Bruce had evidently hired a crew of rough rivermen, for some members of the work force were "made prisoner by some of the citizens of Maysville." Despite this, Major Babcock thought the project was proceeding satisfactorily. He reported on October 3, from Augusta, Kentucky, that steamboats "may *now* ply in all stages of the water without danger; and keels will, I apprehend, go out of use in a short time."³⁴

General Macomb was delighted and urged more frequent reports on the project "as the work in which you are engaged is of great importance, and excites much interest not only in the West, but in this section of the country." But western rivermen were not so pleased, and Congress began to hear from them. Henry Clay received a letter in November, 1825, which castigated both Bruce and Babcock, listed a number of places where the terms of the contract had not been fulfilled, pointed out that the contract had been interpreted to mean only the low-water channel, and urged the removal of Major Babcock, "one who knows nothing of the rivers Ohio and Mississippi, who has never navigated them, who knows not on which side the channel is." The riverman informed Congressman Clay that Major Babcock had accepted work where Bruce had merely trimmed a snag under water and had driven in a stake with a red flag to let boatmen know where it was.³⁵

On December 8 angry rivermen dispatched a denunciation of the work to Congress, arguing that it should not have been let to a contractor, "as contractors, generally, consult their own interest, rather than the public good, which, in the present instance, they do not hesitate to say has been the case." Ten days later, steamboat owners, masters, and pilots

confronted John Bruce at Union Hall in Louisville and complained to him personally. Bruce responded that the contract called for removal only of those obstructions in the low-water channel, that Major Babcock concurred with this interpretation of the contract, and that only if Congress provided an additional sum of \$40,000 would he extend the scope of the project. The rivermen of Louisville sent another memorial of objection to Congress and a letter to Major Babcock, urging him to employ a river pilot to assist in locating the obstructions.³⁶

Henry Clay had passed the first complaint received along to General Macomb, who immediately ordered Captain William H. Chase, Corps of Engineers, to catch the express stage to Pittsburgh and proceed down the Ohio for inspection. The contract called for clearing the whole river and made no allusion to the channel of the river, said General Macomb:

I can hardly believe Major Babcock or Mr. Bruce could have construed the contract in the manner imputed to them; and particularly the latter, who was present when it was formed, and who, in the course of frequent discussion respecting it, became thoroughly informed of the intention of the Government, that the contract was to provide for the removal of all the trees and other obstructions of that nature, so as to render the navigation of every part of the river safe for a draft of ten feet in all stages of the water, when its depth was sufficient for that draft.³⁷

Captain Chase, on his arrival at Wheeling, reported the work accomplished on the uppermost section of the river "exhibits the greatest neglect on the part of the contractor." Chase continued the inspection to Louisville and made similar reports on that section of the river. On December 13, General Macomb informed Bruce that complaints had been received, that an Engineer officer had reported unfavorably on the work done, and that the

contract was therefore suspended pending further investigation. The Chief Engineer suspended Major Babcock from the project, placed him under arrest, and ordered the convening of a court-martial. The Chief also informed Major Stephen H. Long, who was constructing the experimental dam at Henderson at the time, that he was to relieve Major Babcock; he told Long the appointment was made "in the belief that the frequency of your employment on those rivers and the attention you have devoted to the immediate object of the superintendency will have made you familiar with the subject and have rendered you peculiarly qualified for the duty."³⁸

On June 7, 1826, a general court-martial met at Cincinnati to try Major Babcock on four charges: 1) disobedience of orders; 2) neglect of duty; 3) making a false certificate; and 4) making a false statement in an official report. The Major answered "Not Guilty" to all charges and a lengthy trial ensued. Many rivermen testified for the prosecution, as did the pilot of the boat on which Major Babcock had descended the river. Witnesses for the defense included John Bruce, some of his employees, and Samuel McKee. On August 1, the court found Major Babcock guilty on all charges and sentenced him to be dismissed from the service. Nevertheless, it recommended executive clemency because of the novel character of the project and the length of service of Major Babcock to the United States.³⁹

President John Quincy Adams reviewed the evidence in the case. It clearly indicated the problems which resulted in the court-martial derived from the fact that Major Babcock was not qualified by experience for the post to which he was assigned; that he conducted his duties to the best of his abilities; and that his principal

error was accepting the contract interpretation of the contractor. The President concluded the errors of Major Babcock were not intentional and derived principally from the novelty of the project and the difficulty experienced in distinguishing real from imaginary obstructions in the river. The Chief Executive therefore remitted the sentence and ordered that Major Babcock be retained in the service.⁴⁰

Because the expert services of Major Long were required elsewhere in 1826, the War Department appointed Samuel McKee, the chief competitor of Bruce for the contract, to inspect the work and authorized him to employ assistant inspectors. Operations resumed in the summer of 1826, but progress slowed because McKee signed no certificates of completion unless the river was cleared from bank to bank. Work was further delayed when Samuel McKee died in October. His assistant, John Sowers, served temporarily as inspector, while the War Department searched for a qualified man whose appointment would satisfy navigation interests. On the recommendation of Major Long and others, Captain Henry M. Shreve was appointed on December 10, 1826, as Superintendent of Western River Improvements.⁴¹

The Chief Engineer informed Captain Shreve the government could terminate the Bruce contract on January 1, 1827, and exact the penalty for nonfulfillment, but did not wish to do so until after Shreve completed a thorough inspection and reported his opinion of the likelihood of Bruce completing the contract satisfactorily. Shreve reported that though Bruce had a number of machine boats under construction at St. Louis and had reached the mouth of the Green River on the Ohio, just above Evansville, Indiana, he had

neither the means nor capability for completion of the contract. The contract was declared forfeited on April 9, 1827, and the Secretary of War directed Captain Shreve to employ hired labor and personally direct continued operations.⁴²

At the end of the contract, Bruce had 129 men and 13 machine boats at work; he had been paid \$18,563.93 on the contract for work completed and had received the \$1000 contest prize. Bruce employed an attorney and petitioned Congress for remuneration of losses on the contract — losses caused, he claimed, by the failure of the Corps to furnish adequate inspection of the project. In 1833 the Committee on Claims of the Senate referred the Bruce case to Chief Engineer Charles Gratiot (1828-1838), who re-investigated and reported that Bruce was due no additional compensation, but the Senate Committee thought otherwise. Congress awarded Bruce \$6,240.63 in 1834, but rejected his claim made in 1840 for further compensation.⁴³

The Committee on Roads and Canals of the House conducted a thorough investigation of the snag-removal project in 1830. Its astute conclusions were:

The undertaking was new. Persons possessing the requisite practical knowledge of the navigation and the obstructions to the same, of those rivers, could not be, or were not employed at the commencement of the work. The difficulty of removing obstructions which were fastened in the bed of the river, 20, 30, and 40 feet below the surface of the water, was not easily to be overcome. The agency of some machinery, not before in use, for the improvement of our water courses, was deemed indispensable. Much of the time, and a great portion of the money was expended in the necessary experiments, and preparation to commence the work.⁴⁴

Summary

While the contest and contract of 1824 were unproductive of the goals of the first

"Rivers and Harbors Act," the Corps of Engineers learned some important lessons which were to have nationwide application. The snag-machine contest, while it stimulated interest in the project, proved unsatisfactory. The necessary tools and machinery for improving inland waterways could only be developed by men with knowledge of the special problems of river navigation and extensive on-the-job experience. Operations under the Bruce contract demonstrated there were no "prompt and effectual" methods to immediately improve the rivers for free and safe navigation; instead, the improvement of inland rivers would have to be a continuing effort in order to be effective. The Bruce contract also revealed that work on the rivers was so variable that producing results by means of the contract system would be impossible until methods of improvement were developed which would permit the establishment of firm contract specifications and standard evaluation procedures. And, finally, anyone assigned to supervise and inspect navigation improvement projects should first be thoroughly familiar with waterways navigation and improvement methods.

The impact of these lessons was reflected in the act of March 3, 1827, the first of a series of annual appropriations for the Ohio River, which directed that obstructions of "every description" which endangered navigation at "any navigable stages" and on the banks and sides of the river were to be removed. It also directed that "some practical agent" thoroughly acquainted with the navigation of the Ohio River be placed in charge of the project.⁴⁵

Under the capable direction of the "practical agent," Captain Henry M. Shreve, from offices at Louisville, Ken-

tucky, the improvement of navigation on the Ohio and Mississippi rivers proceeded in 1827. Captain Shreve extended improvement operations, as directed by Congress, to the Missouri, Arkansas,

Cumberland, Red, and other rivers during the following decade and developed the machinery and methods necessary to accomplish the task, with immense benefit to the navigation of the inland waterways.

CHAPTER IV: IMPROVEMENT OF THE FALLS OF THE OHIO, 1783-1860

The Corps of Engineers launched its program for the improvement of navigation on the Ohio River in 1824, but for several reasons, chiefly political, Congress did not authorize a federal project for the improvement of the Falls of the Ohio, the worst obstruction to navigation on the river, and that project was undertaken by a private corporation. The hydrographic studies of Thomas Hutchins in 1766 publicized the nature of the obstructions at the Falls and indicated that improvements to navigation were feasible. It will be recalled that Thomas Jefferson, after study of the Hutchins map, speculated on possible improvement methods at the Falls as early as 1781.

During the late eighteenth century, as an extensive flat and keelboat traffic developed on the Ohio, several methods of improving the Falls were suggested; and after 1800 several private companies, chartered by state legislatures, funded engineering studies of the Falls and made abortive attempts at improving navigation. When the immense development of steamboat commerce began after the War of 1812 the improvement of navigation at the Falls became imperative, and, in the face of federal inaction, the Commonwealth of Kentucky chartered the Louisville and Portland Canal Company in 1825. With the aid of state and federal funds, this company completed the construction of a canal around the Falls of the Ohio in 1830. By the time the canal was completed the federal government had become a major stockholder in the corporation, but despite repeated urging by river interests, who wished the removal of excessive tolls, Congress refused to purchase the remainder of the stock and convert the canal to a toll-free federal pro-

ject. The corporation eventually, as authorized by the Kentucky legislature in 1842, used its profits to purchase privately owned stock and delivered it to the federal government. By 1855, except for five shares held by the directors of the corporation, the United States was the sole owner of the canal, but Congress chose to leave the control and management of the canal to the directors; and the Louisville and Portland Canal Company became one of the first, if not the first, public corporation in the United States, a forerunner of the modern Tennessee Valley Authority and United States Postal Service.¹

Congress authorized the improvement of the Louisville and Portland Canal after the Civil War, and the Louisville and Portland Canal project became the responsibility of the Corps of Engineers. The officer assigned to the project was permanently stationed at Louisville, and thereby became the first District Engineer of the modern Louisville Engineer District. A review of the history of the Louisville and Portland Canal prior to the formation of the Louisville Engineer District is therefore in order.

Falls of the Ohio: Problems of Navigation

English explorers and British Army Engineers wrote relatively accurate descriptions of the Falls of the Ohio long before the region was settled — those written by John Peter Salley in 1742 and Captain Harry Gordon in 1766 will be recalled — and practically every traveler on the Ohio who kept a journal recorded his impressions of the worst navigation obstruction on the river. The Falls were formed by an irregular mass of limestone underlying the entire width of the river for a distance of about two miles, forming, in effect, a

natural dam. The river was wide and relatively deep above the Falls, while below it was about half as wide with a lesser navigable depth for about fifty miles. The name "Falls" was a source of some confusion to early navigators, who often expected to find a precipitous cataract, whereas the Falls of the Ohio were not even visible at flood stages. The contraction of the river below the Falls caused the lower pool to rise more than twice as fast during floods than the pool above the Falls, until, at the highest stages, the gradient of the slope was so reduced as to permit navigation with relative ease. But such high stages ordinarily occurred during less than two months of any single year, and for the remainder of each year the whitewater rapids of the Falls made navigation exceedingly hazardous.²

Early descriptions of the Falls of the Ohio reported the gradient at the Falls at low water at from twenty-two to twenty-eight feet. (In 1914, it was officially reported as 25.24 feet.)³ There were three channels, or chutes (also "shoots"), over the Falls known as, proceeding from the Indiana to the Kentucky bank, the Indiana (also Indian) Chute, the Middle Chute, and the Kentucky Chute. As the river rose, the Indiana Chute first became navigable, followed by the Middle Chute, and finally the Kentucky Chute. Two projecting rocks in the Indiana Chute, about fifteen feet apart, practically standardized descending flatboat traffic at a width of fourteen feet.⁴

At low-water seasons, teamsters and the drayage industry between Louisville and Shippingport flourished, while waterborne commerce languished. Not long after Louisville was founded in 1778, professional Falls pilots who guided waterways traffic over the Falls were in business. Before the Civil War the Falls pilots, on occasion aided by the Corps of En-

gineers, took advantage of extreme low water to clear especially hazardous rocks from the Falls chutes. With the possible exception of some snag removal accomplished by the firm of Tarascon and Berthold in 1818 in the harbor at Shippingport, this was the first improvement of navigation over the Falls. Support of the Falls pilots and other navigation interests for improving navigation over the Falls eventually led to Congressional authorization of a federal project for that purpose in 1874, but most early efforts to improve navigation at the Falls were devoted to the construction of a canal, or canals, bypassing the obstructions.⁵

Early Canal Projects, 1783-1812

Perhaps the first proponent of a canal around the Falls to actually attempt to initiate a project was Christopher Colles, an eminent Irish-American civil engineer. Colles, a notable advocate of the construction of the Erie Canal in New York state, like George Washington and Thomas Jefferson, studied the maps of the Ohio River and the Falls prepared by Thomas Hutchins, and he came to the conclusion that the best method of improving the Falls would be by the construction of a canal. On July 4, 1783, he petitioned Congress for a land grant at the Falls, proposing to form a company to construct and operate a canal and thereby open an all-water route for settlers bound for the West. But his petition was not granted.⁶

All states and, in the earliest days, territories (Ohio achieved statehood in 1803; Indiana in 1816) bordering the Ohio River above the Falls became interested in canal projects at the Falls to varying extents; and several canal companies which proposed to accomplish the feat were chartered by state and territorial legislatures in the early nineteenth century. The

state of Ohio was especially active, supporting projects sponsored by both the Commonwealth of Kentucky and the Territory of Indiana. But therein lay the principal complication which early canal companies met, for the states could not agree on the canal location.

The Territory of Indiana incorporated the Indiana Canal Company in 1805; it had some distinguished directors, including General George Rogers Clark, Congressman Jonathan Dayton, General Benjamin Hovey, former Vice President Aaron Burr, and others. General James Wilkinson, who had launched commercial trade with New Orleans via the waterways in 1787 and who had suffered heavy losses at the Falls of the Ohio, lent his support to the Indiana Canal Company. He claimed the project, in addition to its benefits to navigation, could provide valuable water power for industry. He declared that the preminence of the Falls of the Ohio area could not "in point of locality and fitness for the grand emporium of internal commerce, be controverted; its position at the head of easy navigation, and its central relation to the most extensive, luxuriant and productive tract within the national limits, or perhaps in the universe, will, at the first glance, decide, that commercial enterprize is to find its way to this point from the ocean, and that here the primary exchange of products for imports is to take place."⁷

The company petitioned President Jefferson and Congress for federal aid for the project, asking a grant of twenty-five thousand acres of public lands to sell and thereby fund the project. Whether this company actually intended to construct a canal, or whether there were other motives behind its organization was questioned. Some suspected that its real purpose was to form an unauthorized banking

business; and the participation of General Wilkinson and Aaron Burr in the enterprise later led to speculation that it was organized as a cover for the Burr Conspiracy of 1806. Whatever the motives, Congress refused to authorize the use of public lands for the stated purposes.⁸

Louisvillians, led by James Berthold of the firm of Tarascon and Berthold, organized a state-chartered company, the Ohio Canal Company, in 1804 and employed a former officer of the Corps of Engineers to study and map the Falls and prove the advantages of the canal site on the Kentucky bank. Jared Brooks, who had served as a Lieutenant in the First Regiment of Artillerists and Engineers, conducted extensive studies of the hydrology of the Falls of the Ohio in 1805, made a detailed survey of the area, sank shafts to investigate the character of the subsoil and rock strata, and prepared a map which clearly proved the best canal route lay along the Kentucky shore. Brooks laid out the route which was eventually followed by the Louisville and Portland Canal. The Kentucky legislature forwarded the report of Brooks to Congress along with a request for federal aid; and in 1806 a committee of the House reported that on the basis of Brooks' studies it would recommend federal aid for the canal project if the revenue of the United States had not been "already pledged" for other purposes.⁹

At the request of Henry Clay and other congressmen from the Ohio Valley, further study of the canal projects at the Falls was authorized as part of the comprehensive study of American transportation problems conducted under the direction of Secretary of Treasury Albert Gallatin in 1807. Jared Brooks provided the Secretary with maps of the Falls area and a lengthy report on the subject. According to Brooks, the "dormant wealth of this im-

portant section of the national domain can be brought into life and action only by a free and open navigation, and the assistance of water-works for the encouragement of manufactures." The canal at Louisville, he contended, would meet those two overriding needs. Secretary Gallatin was impressed by these arguments and by the fact that sea-going ships were regularly descending the Ohio at that time, and he recommended in his report of 1808 to Congress that three hundred thousand dollars in federal funds be appropriated to construct the canal project; but no action was taken on this, or on his other recommendations.¹⁰

Indiana Falls Canal Projects

After the War of 1812, the growth of steamboat commerce and the increasing economic development of the Ohio Valley led to renewed efforts to bypass the Falls with a canal. One of the first laws enacted by the first state legislature of Indiana in 1816 incorporated the Ohio Canal Company, but the company did not take advantage of its charter and in 1818 the state chartered a third Falls canal company. The Jeffersonville Ohio Canal Company, financed largely by Cincinnati capital, actually initiated canal excavation on the Indiana bank, but the clays of Clark County, Indiana, proved to be more durable than the funds available to the company. Studies of possible canal sites on the Indiana bank of the Falls of the Ohio continued until well after the Civil War, usually inspired by public displeasure with the limited size and high tolls of the canal completed on the Kentucky bank, but no such project was ever completed.¹¹

Creation of Louisville and Portland Canal Company

Near the end of the War of 1812, La-

ommi Baldwin, a distinguished American civil engineer prepared plans for a canal for keelboats along the Kentucky bank, but the Kentucky canal company could not find the financial support necessary to initiate construction. The canal projects at the Falls were caught up in the economic rivalry between the Queen City, Cincinnati, and the Falls City, Louisville. A Cincinnati newspaper editor accused Louisville in 1818 of covert opposition to a canal, or at best support for the construction of an "inefficient" keelboat canal. He wrote: "the moment a canal is constructed sufficient to convey boats up and down the falls, that moment Louisville *sinks* to a level with other towns on the river. . . ." The editor of the Louisville *Public Advertiser* responded that Louisvillians were "really anxious" for construction of the canal, and accused Cincinnatians of supporting canal projects on the Indiana bank of the Falls because such a canal would be a blow to Louisville.¹²

There were some, chiefly those in the business of transporting freight around the Falls, who were opposed to canal projects in 1818, but support for the project was building. Henry McMurtrie, the Louisville historian, argued in 1819 that the construction of a canal around the Falls, that "formidable and intimidating spot, whose terrors have paralyzed the arm of enterprise," would be a boon to the commerce of Louisville and the entire Ohio Valley. He declared the canal was vital to the security of New Orleans and the Gulf Coast and suggested that the United States should establish a military depot at the Falls where the "munitions of war" might be speedily dispatched down the waterways by steamboat. McMurtrie urged the aid of the federal government in the canal project, and declared that the project would never be constructed with-

out aid from the United States, "whose aid and countenance in this undertaking every inhabitant of this section of the Union sincerely prays for."¹³

When the Commission representing Ohio Valley states reached the Falls of the Ohio at the end of the survey of the Upper Ohio in 1819, as directed by participating states, the members examined the Falls of the Ohio to compare the proposed Kentucky and Indiana canal projects. They collected previous engineering reports, resurveyed the Falls, and recommended the construction of a canal on the Kentucky side. They estimated the costs of the Kentucky canal at less than \$400,000, while the Indiana canal might cost as much as \$1,000,000. The Army Engineers, commanded by General Simon Bernard, who continued the survey of the Ohio in 1821, began their work with an examination of the Falls area and proposed canal routes. Because Congress had not directed it, they did not report their opinion of which might be the most desirable canal route, but their figures substantiated the previous reports of Jared Brooks and the Joint Commission of 1819.¹⁴

In 1823 the state of Ohio directed Judge David S. Bates, who had acquired his engineering expertise and experience on the Erie Canal project in New York state, and Alfred Kelly, an Ohio state canal commissioner, to reexamine the Falls. The two engineers reported the canal route on the Kentucky bank was most feasible and least expensive, commented that the "business of the country above the Falls annually, pays a tax to this rock of greater amount than it would cost to make the improvement," and estimated that benefits of the project would consist of savings of \$150,000 in transportation costs annually. The report of the Ohio engineers, along with an offer from the state of Ohio to join

Kentucky in funding a project, was presented to the Kentucky legislature in 1824. An extended debate ensued in the Kentucky legislature over whether the state should construct the project, or whether a state-chartered private corporation should be given that privilege. The controversy was settled in favor of the proponents of construction by a corporation; and a bill establishing the Louisville and Portland Canal Company was signed by the Governor of Kentucky on January 12, 1825.¹⁵

Initial Construction

Citizens of several states purchased stock in the new canal company, but private capital came principally from Philadelphians, who hoped to use a canal over the mountains to Pittsburgh and the Ohio River as a trade route to the West, competing with the Erie Canal in New York state which was completed in 1825. The Louisville and Portland Canal Company selected Judge David S. Bates as chief engineer of the project. He served concurrently as chief engineer for the canal system under construction in Ohio, and his son, John Bates, and Alfred Barrett, another former Erie Canal engineer, had immediate supervision of the Louisville project.¹⁶

Judge Bates' plans called for a canal about two miles long from the harbor before Louisville through the Portland section to rejoin the river below Shippingport. He estimated that 112,000 cubic yards of rock and 633,358 cubic yards of earth would be excavated from the canal and lockpits. Three lift-locks, each to be 190 feet long, 50 feet wide, with a lift of eight feet, eight inches, were located at the lower end of the canal. A massive guard lock was to be constructed at the head of the lift-locks to protect them from

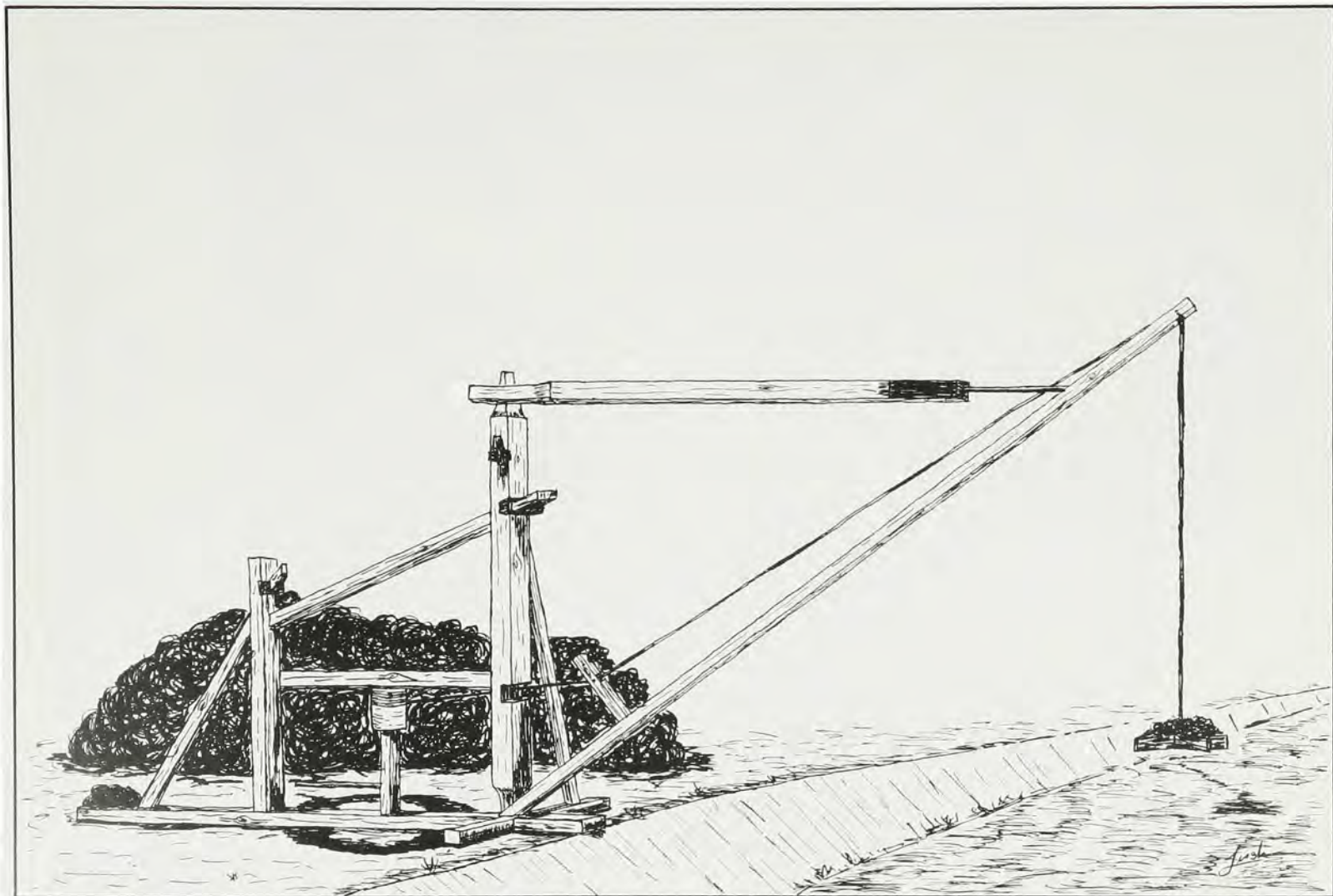
drift and silt during high water periods. Judge Bates estimated the locks would require the placement of some 30,000 perches (about 25 cubic feet per perch) of stone masonry. But the estimates were quite rough, specifications were not firm, and detailed plans were not in existence. It was the custom of pioneer canal engineers to prepare only general plans and work out the details as the project progressed; planning was flexible, usually on an empirical basis, and extensive modifications to the Louisville canal project were effected during the course of construction.¹⁷

The canal company advertised for bids from contractors on October 22, 1825, stating their intention to have the work completed in the "shortest possible time" and requesting that sealed bids be submitted by December 22, 1825. About twenty-five bids were received from contracting firms of several states; and in late December the contract was awarded to the lowest bidder, Chapman, Culver, Lathrop, Collins, Perrine, & Company, formerly contractors on the Erie Canal. Their bid was for about \$370,000, nearly twenty percent less than the estimated costs, with completion scheduled for November 1, 1827. It appears the work was somewhat larger than the contractors could handle independently, for they subcontracted portions of the excavation to the firm of Southerland and Adams and lock construction to the Carney and Sayre Company. The first work began on March 1, 1826, but construction was held up for a month by continued high water. Only about 35 men and their teams were employed in grubbing and clearing the line of the canal during the first few months of construction, and considerable difficulty was met in employing laborers during the summer of 1826 because of a smallpox epidemic in

the vicinity of the project. But by the end of the summer some 1000 hands were at work; and lock construction was initiated in September. To supervise construction of the locks, Judge Bates employed John R. Henry and young Increase A. Lapham, who had previously been employed on the Erie Canal in the design and construction of the elaborate five-flight lock structure at Lockport, New York. When John Bates and Alfred Barrett left the project, John R. Henry became resident engineer, with Lapham as his assistant.¹⁸

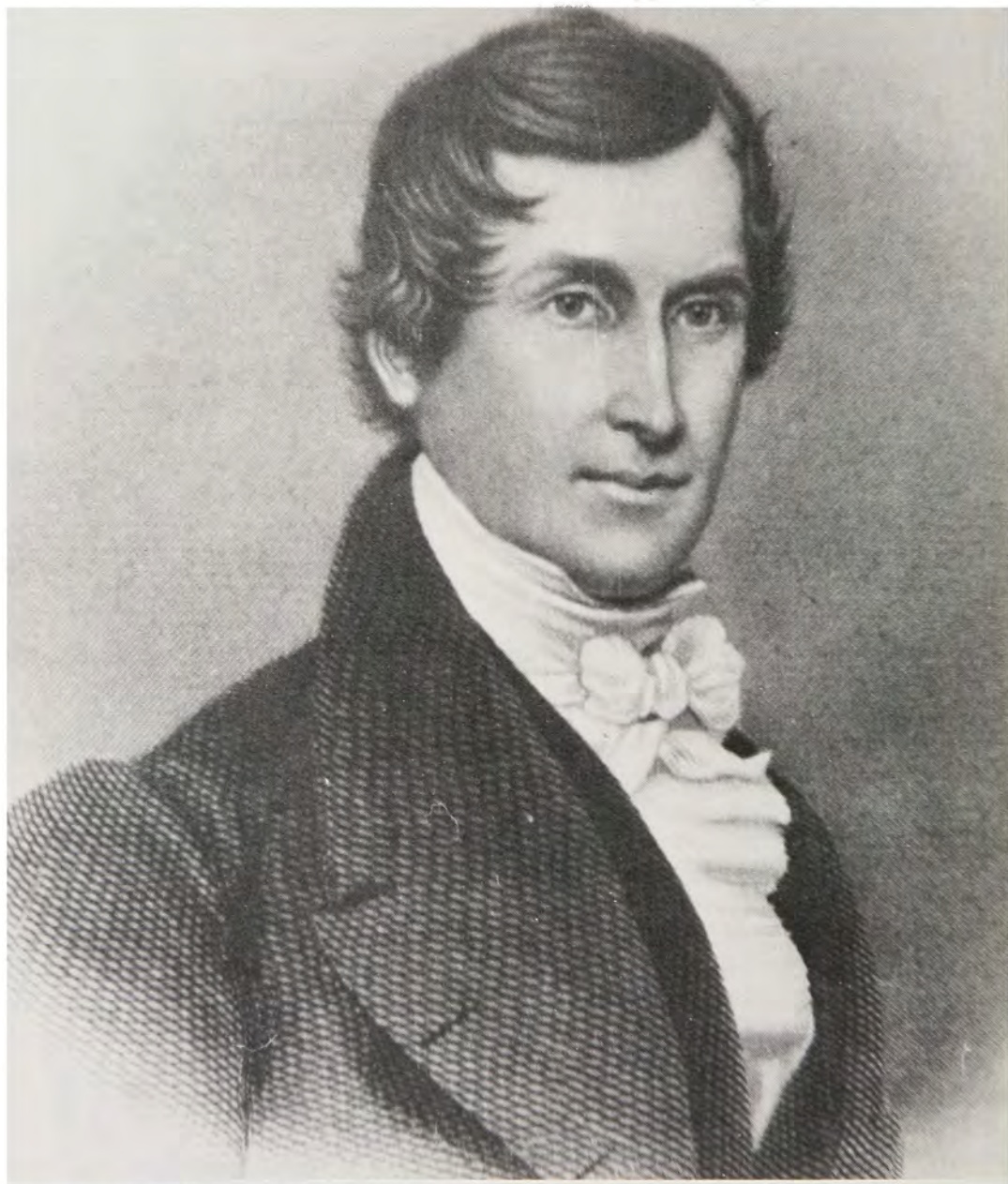
Excavation Methods

The techniques utilized for construction of the Louisville and Portland Canal in the late 1820s did not materially differ from those used on the Egyptian pyramids and Roman aqueducts milleniums before. The contractors at the canal, like the Ancient builders, relied on human and animal power. Excavation was accomplished with hand tools, oxen-drawn plows, and scrapers dragged by horses; and the excavated materials were removed by wheelbarrows and horse-drawn carts. The principle advance in excavation techniques between Roman times and the nineteenth century was the use of gunpowder for rock excavation. In the lockpits and canal cross-section, holes were drilled into the rock by men using sledgehammers and hand drills, the holes stuffed with black gunpowder, and clay tamped in atop the powder, leaving small apertures for priming powder and a fuse, which was ordinarily a twist of paper soaked in saltpetre. Holding a drill while men pounded it with sledgehammers and blasting rock with black powder was a dangerous business and accidents were frequent. The laborers employed on the project were a rough crew of Irishmen, many of whom came to the work from other canal projects, and a



(Sketch by Increase A. Lapham, Wisconsin Historical Society Library)

DIBBLE CRANE FOR RAISING MATERIALS FROM EXCAVATION AT LOUISVILLE AND PORTLAND CANAL, 1827



(Engraving from Charles B. Stuart, *Lives and Works of Civil and Military Engineers of America*, 1871)

CANVASS WHITE, 1790-1834

"Genius of the Erie Canal" — patented hydraulic cement in the United States. Consulting engineer on the Louisville and Portland Canal.

large member of slaves hired from their masters. It has been claimed that, because of their rough character, the sobriquet "Hoosier" was first applied to the workmen at the Louisville canal.¹⁹

Mechanization

Several efforts were made to mechanize construction methods, chiefly to facilitate removal of the excavated materials after the depth and side slopes of the canal were too great for easy handling. A stiff-legged timber crane, supposedly invented by Mr. Orange Dibble on the Erie Canal, was put into use in raising loads of material from the bottom of the excavation. Another device, invented by Mr. Oliver Phelps on the Welland Canal, was also put into use. It consisted of a windlass at the top of a timber railway running up the canal slope. A horse-drawn train of loaded carts at the bottom of the slope had a rope attached to its front; the rope ran up the slope, around the windlass, and was attached to the back of an empty cart train, also pulled by horses, going down the slope. The weight of the empty cars and the power of the teams pulling them was thus added to the power of the teams pulling the loaded carts up the slope.²⁰

Lock Construction

The walls of the locks and canal were constructed of cut stone masonry, on the same principles developed by the Ancient builders. Stone for the project was quarried a few miles below the site and transported up river. In 1827 the canal company employed Canvass White, who had won the sobriquet "Genius of the Erie Canal," as consulting engineer. White had studied canal and lock construction in Europe on behalf of the New York project, and during the construction of the Erie Canal had discovered "waterproof lime,"

actually the first hydraulic cement in America. He conducted experiments with various limestones and found a variety which, when burned, pulverized, and mixed with sand, formed a mortar which hardened in water. White found that the limestone excavated from lockpits at the Louisville canal would serve the same purpose. A steam mill was constructed to grind the stone to powder, for use in binding the masonry in the lock walls together — it was reported this grout soon became harder than the stone used in the construction. By 1874 eight hydraulic cement factories, with an annual production valued at a million dollars, were in business at Louisville.²¹

The total amount of masonry placed in the lock and canal walls and in the stone bridge over the canal was approximately 41,989 perches, equal to the amount used in thirty ordinary canal locks of the era. The guard lock and three lift-locks all had solid rock foundations. As completed, the guard lock was 190 feet long, 52 feet wide, and 42 feet high, containing 21,775 perches of masonry. The three lift-locks were the same width as the guard lock, 20 feet high, and 183 feet long, with a lift of eight feet, eight inches each. The length of the walls, from the head of the guard lock to the end of the outlet lock was 921 feet. Two bridges, one of stone and the other of wood, spanned the canal. The stone bridge, which had three arches, was 240 feet long and contained 5,741 perches of masonry, was erected by Carney and Sayre Company for \$20,000. The wooden draw bridge, completed by a contractor named Tanner for \$850, accommodated traffic between Portland and Shippingport. Built over the head of the guard lock in a position similar to that of the metal draw bridge at McAlpine Locks in 1975, it was in two parts (Bascule) and was raised

and lowered by chains running through windlasses, with boxes filled with stone, old grate bars, and other heavy materials as counterbalances.²²

Contractor Failures and Federal Participation

Many citizens who pledged to purchase stock defaulted at the commencement of construction in 1826, but the project was saved by an appropriation of Congress for purchasing the forfeited stock. The United States became a major stockholder in the corporation, but it appears the federal government made no effort to influence company policies or aid construction in any other manner. When the original contractors failed in 1828, apparently because of the high costs of excavation and the necessity of paying high wages to attract workers, which considerably exceeded contract estimates, Congress again saved the project by purchasing the rest of the forfeited stock. The company renewed work, serving as its own general contractor and reducing costs by modifying a number of project features.

The width of the walls of the lift-locks was reduced and buttresses on the back side of the walls were eliminated. Rock excavation ceased and many projecting rocks were left to plague navigators at a later date. John R. Henry was retained as project engineer for the directors; Increase A. Lapham continued as assistant engineer; and a number of former subcontractors were hired as overseers. Seven new contracts were let for various unfinished sections of the project; and in the working season of 1830 the canal was completed.²³

First Boats Through and Final Costs

On the first of December, 1830, water rose nearly to the top of the cofferdam at

the head of the canal, and the dam was removed to permit filling of the canal. Flatboats passed through the canal in early December, and on December 21 the first steamboat, the *Uncas*, Captain Beer, with full cargo bound for Nashville, locked through. One of the first vessels to use the canal was a flatboat from Cleveland, Ohio, which had navigated the Ohio state canal system and the Muskingum River to Marietta and proceeded down the Ohio on its way to New Orleans.

Although the directors of the Louisville and Portland Canal Company listed construction costs at \$742,869.94, actual costs, including interest on funds borrowed to complete the project, were \$1,019,277.09. Captain Thomas Cram, Corps of Engineers, who investigated the project at the order of Congress in 1844, concluded that, though actual costs were nearly three times the original estimates:

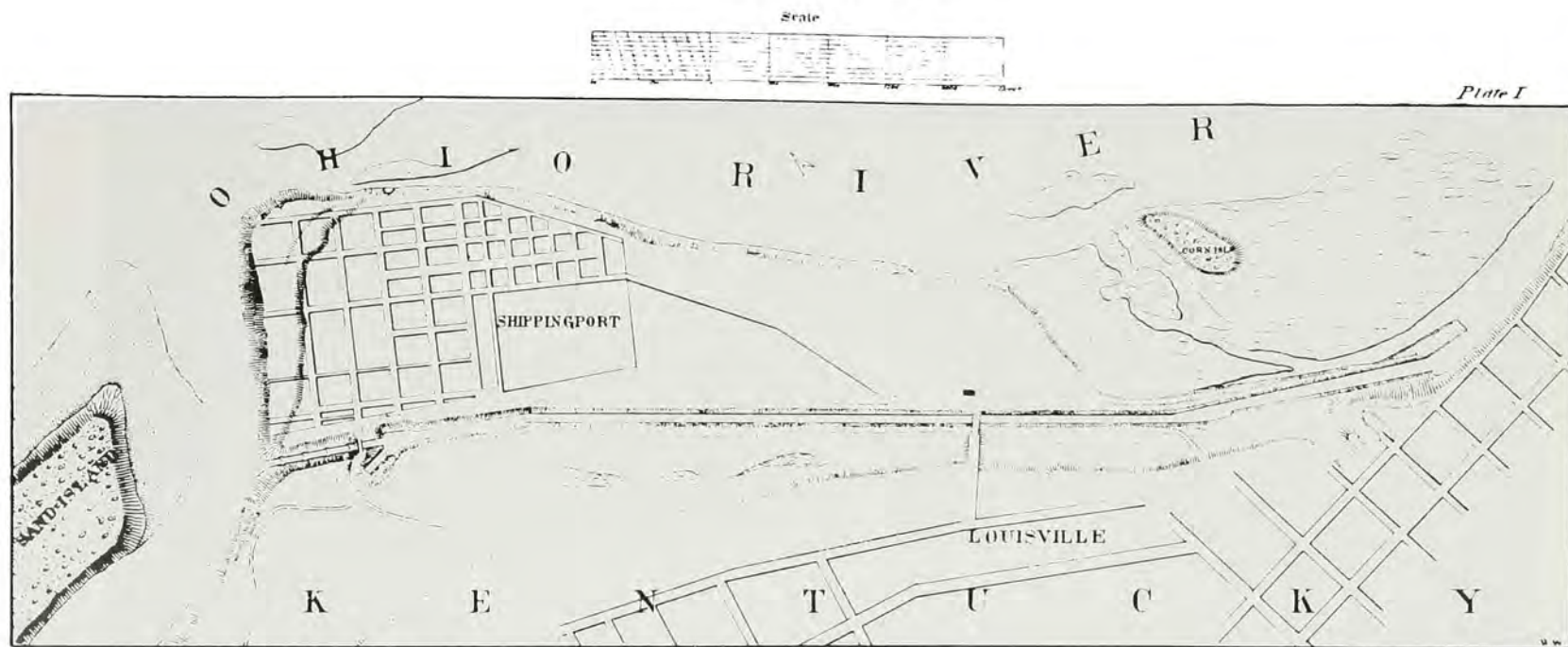
Considering the numerous difficulties experienced by the company in the outset, and during the progress of their undertaking, the want of confidence in the success of the work, evinced by the fact that almost all the subscribers living in its vicinity forfeited their stock after having paid installments thereon, it may be said on the whole that the cost of the Louisville and Portland canal was reasonable.²⁴

Canal Operation

During the first 104 days of operation, 827 boats, 406 of them steamboats, locked through. The editor of *Niles' Weekly Register*, a journal with national circulation, commented: "And yet this noble and beneficent undertaking was thought by the advisers of the executive, to be too contracted and diminutive a concern to deserve the aid of the general government. If such works as these be not national, what shall we call so."²⁵

Numerous problems which delayed navigation were experienced in operation

CONDITION
OF THE
LOUISVILLE AND PORTLAND CANAL.
BEFORE ENLARGEMENT



Note. From survey made by Lt Col S.H. Long T.E. 1846.



(Record Group 77, Natinal Archives)

Louisville and Portland Canal — Three flight locks completed by the Louisville and Portland Canal Company in 1830. Photo probably taken in 1874.

of the project. Extensive deposits of mud and debris were left in the locks and canal after each flood. The flood of 1832, which left a number of wrecked houses in the canal, required extensive repairs and alterations to the project. In 1833 a steam-powered dredge, of the "endless-chain-of-buckets" or ladder type, was built to remove mud and silt. Later dredges were the dipper type. The wooden lock-gates were opened by chains attached to manually operated capstans mounted on the esplanades. Lockmen turned the capstans, winding the chains around drums, to maneuver the gates. It was a slow process requiring an hour and a half to pass a single boat through the series of locks; delays as long as five hours in passing the canal and locks were frequent.²⁶

The number of vessels using the canal still increased; more than a thousand vessels locked through in 1835, and an average of 1300 passed through every year thereafter until the onset of the Civil War. Tolls collected from this commerce made the canal a profitable enterprise from the first, and stockholders averaged a return of eight percent annually on their capital. The Governor of Kentucky lamented:

It must be a subject of perpetual regret to every patriotic mind that the state did not, with her own resources, undertake the construction of the canal at Louisville. It would have been an imperishable fund — a source of revenue as lasting as the Ohio River itself — which would have enabled the government to accomplish the most extensive and useful plans without increasing the burdens of the people.²⁷

But there were segments of the population of the Valley who did not appreciate the canal. On January 23, 1833, several kegs of gunpowder were deposited in the locks and detonated. One of the locks was heavily damaged, and the company offered a \$5000 reward for the capture of the

perpetuators, but the culprits were not found. There were also attempts to blow up the stone bridge; and boats loaded with coal were sunk at the head of the canal. It was suspected the saboteurs were disgruntled draymen whose business had been reduced by the opening of the canal.²⁸

Limitations of the Canal

The principal value of the Louisville and Portland Canal was that it permitted shipment of goods from the Upper Ohio Valley without transferring cargoes at the Falls and reduced the delays which often resulted in alternate glutting and famine at the New Orleans and other downriver markets. But this value was limited by certain defects in planning. The stone bridge over the line of the canal had a clearance of sixty-eight feet at low water, and boats with high stacks had to lower them to pass under. The lock chambers, designed for vessels used on the rivers in the 1820s, limited hull dimensions to 183 feet long by 49½ feet beam; and by 1853 over forty percent of the steamboats on the Ohio were too large to pass through the canal. Steamboat designers increased the draft on vessels to enlarge cargo capacity, and steamboats were often seen backing through the canal, or "crabbing through," to thrust available water back under the hull and drag the boat across accumulated silt on the canal bottom. These limitations were often complained of by rivermen, but the principle objection was to the high tolls charged at the canal.²⁹

The original toll was twenty cents per ton, but high maintenance and operation costs, chiefly due to the damages resulting from repeated floods, necessitated an increase to forty cents in 1833 and to sixty cents in 1837. These toll increases substantially reduced the savings in transpor-

tation costs for which the citizens of the Ohio Valley had hoped. At Pittsburgh, Cincinnati, St. Louis, and other ports on the inland rivers, navigation and mercantile interests held protest meetings and sent petitions to Congress, contending that collection of tolls at the canal was a burdensome monopoly, that the tolls were an excessive tax on Ohio Valley commerce, and that, because the Ohio River was a national highway, the project should be taken over and operated by the United States.³⁰

The directors of the Louisville canal operation never sought to retain control over the project and were always ready to sell out to the United States, for Louisvillians were in accord with residents of other port cities on the subject of the tolls. The Louisville Chamber of Commerce resolved in 1840 that the tolls seriously retarded "commercial operations and the transportation of merchandise." And the president of the canal company wrote in 1844 that the United States should take over the project because:

It cannot be controverted that this tax [tolls] is paid indirectly by the agricultural products of the west and south, and the manufactured goods of the east, as well as by passengers travelling on the Ohio from all parts of the Union. Were this tax entirely removed, the competition existing among steamboats for freight would soon cause them to consider it an expense to the carrying trade the less; and the result would be a proportionate reduction, to a great degree, on the cost of transportation. This fact, however, only proved the truly national character of this work — every citizen of the Union being more or less interested in the reduction of the toll; and that the saving would not be confined to steamboat owners alone.³¹

Three schools of thought had developed on the subject of the improvement of the Falls of the Ohio by 1840. The majority of those interested in the problem supported national ownership and operation in such

a manner as to eliminate or substantially reduce the tolls at the existing canal. A second group supported the Falls pilots in efforts to gain federal aid for a project to improve navigation by open channel over the Falls. And a third group advocated the construction of a second canal along the Indiana bank — in 1836 Indiana chartered the Jeffersonville and New Albany Company, which proposed to construct such a canal to create two-way traffic around the Falls.³²

The improvement of the open channels at the Falls was most vigorously supported by the Falls pilots who had to navigate them. In the 1830s the pilots expended some of their own funds in closing secondary channels and removing dangerous rocks from the Indiana Chute; and some small federal aid was provided for the work. Lieutenant Jacob A. Dumeste, by order of the Secretary of War, surveyed the channels over the Falls in 1830; and in 1834 Captain Henry M. Shreve, as agent for the Corps of Engineers, reported to Congress on open-river navigation at the Falls. Shreve advocated blasting rock from the Indiana Chute and placing it in dams across little-used channels to increase water volume through Indiana Chute and the Louisville Canal. But this work was left chiefly to the enterprise of the Falls pilots.³³

Water Power at the Falls

The United States was very much interested in the water power available at the Falls, for after the War of 1812 considerable support for the construction of a national armory on a western river where watercraft could quickly distribute munitions to armies on the frontiers developed. In 1819 President James Monroe expressed his opinion that the Falls area would

be a most suitable location for an armory; and in 1825 the Kentucky legislature ceded, by joint resolution, jurisdiction over lands which might be acquired at the Louisville canal for a national armory to the United States. The hope that a national armory might be located alongside the canal may have given added impetus to the canal project in 1825; at least, an officer of Army Ordnance discussed the subject with the company in that year.

Colonel George Bomford of Ordnance negotiated an agreement with the Louisville and Portland Canal Company for use of the water power made available by the canal. Colonel Bomford estimated that a national armory would require about 200 acres of land and water power sufficient to work twelve pair of five-foot burr millstones for ten to twelve hours per day. The company agreed to furnish the necessary water power for \$3600 annually, and the lands of Senator John Rowan along the canal line were available as a site. But no action was taken by Congress because the location of the national armory in the West became a controversial political issue. Citizens and their representatives near practically every water fall on the inland rivers urged that the armory should be constructed at their site, rather than at Louisville.³⁴

In 1828 and 1829, Captain John L. Smith, Corps of Engineers, aided by Lieutenant George Whistler, examined potential armory sites throughout the Ohio Valley, and found acceptable locations on the Wabash and Big Blue rivers in Indiana, on the Licking River in Kentucky, and at the Falls of the Ohio. But Congress found itself unable to agree upon a single site, and in 1842 directed that another survey be conducted. General Walker K. Armistead and Colonel Stephen H. Long of the Army Engineers

and Surgeon General Thomas Lawson again investigated numerous sites in the Ohio and Mississippi valleys. Because steam-powered machinery had been perfected, it was no longer necessary to locate the armory at a falls where water power was available, and the officers recommended the construction of a national armory at Fort Massac, Illinois, near the mouth of the Ohio, which was more centrally-located to navigation on the Mississippi River system than Louisville. But Congress again found it impossible to come to agreement on the site, and a national armory in the West was not constructed until the exigencies of civil war required it. The water power available at the Falls of the Ohio was thus left for private rather than public development.³⁵

Politics and the Canal

Political controversy also prevented the acquisition and operation of the Louisville canal as a toll-free federal project. Though the directors of the canal, the legislature of Kentucky, and navigation interests on the inland waterways continually supported bills in Congress to convert the canal to a national project and remove the burdensome tolls, opposition came from two quarters. Indianians still hoped a canal would be constructed along the Indiana bank of the Falls and they supported federal construction of this canal, rather than federal acquisition of the Louisville canal. And many citizens throughout the United States maintained that federal control and operation of the canal was beyond the constitutional authority of the United States. This opposition successfully blocked every bill in Congress which would have established federal control of the Louisville and Portland Canal. By 1855, however, federal ownership of the canal was almost complete.³⁶

During construction of the project, the United States had purchased and acquired 2,092 shares, at a cost of \$233,500, in the canal corporation. During the first decade the canal was in operation, the United States was paid \$257,778 in dividends on its stock — more than the original purchase price — while private stockholders received more than double that amount in dividends. In 1841, private stockholders proposed to buy themselves out, since Congress would not do so with appropriations, by applying dividends due the United States to purchases of the private stock; and the legislature of Kentucky authorized this procedure on January 21, 1842.³⁷

Congress did not dissent, and by 1855 the United States was the owner of 9,995 shares of canal stock; nevertheless, Congress still refused to accept the canal as a government project, and five shares remained in private hands to qualify their holders as directors of the corporation. The Louisville and Portland Canal Company thus became a public corporation, owned by the United States but operated by directors independent of control by Congress. While perhaps politically advantageous, this administrative organization produced the paradox of the collection of a heavy tax on commerce at the Falls of the Ohio while the remainder of the river was under federal improvement with the purpose of reducing transportation costs — a situation which was to continue until 1880. Precise computations have not been made, but it appears the United States collected more in tolls at the Louisville canal prior to 1860 than it expended on the improvement of the entire Ohio River.³⁸

Summary

The hydrographic studies of Thomas

Hutchins first indicated the feasibility of a canal project to bypass the obstructions at the Falls of the Ohio, and the surveys of Jared Brooks, a former Army Engineer, proved that the shortest and most economical canal route at the Falls lay along the Kentucky bank. Later studies of the Falls conducted by the joint commission appointed by Ohio Valley states in 1819 and by an Army Engineer survey party in 1821 confirmed the findings of Jared Brooks. But, in the face of Congressional refusal to authorize and fund a definite federal project, proponents of canal projects on the Indiana and Kentucky banks of the Falls engaged in an extended political controversy which, in conjunction with limited capital, prevented any substantial improvement of navigation at the Falls of the Ohio until 1825.

The Louisville and Portland Canal Company, a state-chartered, private corporation, completed construction of the massive canal project on the Kentucky bank of the Falls in 1830, but it required federal and state financial support to accomplish the feat. And, in view of the crude construction methods of the era, the canal was an engineering feat of considerable magnitude, equal in scope to much larger projects constructed in the twentieth century with the aid of modern engineering technology and construction methods. The chief problems with the completed project were two: marine engineers on the inland rivers developed vessels much larger than the capacity of the locks of the Louisville canal; and the high tolls at the canal, which in the end were paid by consumers, materially reduced the value of the project to the Ohio Valley.

Political controversy and constitutional issues prevented federal construction and operation of the project and prevented the construction of a national armory to take

advantage of the water power at the site. The United States did not assume complete responsibility for the improvement of the Falls of the Ohio for navigation until 1874; nevertheless, its interest and limited participation in the construction of the pre-Civil War project did make possible the completion of the canal in 1830, and the United States became the principal

stockholder in the corporation not long thereafter. The Louisville and Portland Canal project foreshadowed later projects for improving navigation and developing the latent power at the site, formed the foundation on which subsequent projects were based, and eventually led to the formation of the Louisville District, Corps of Engineers, United States Army.

CHAPTER V: ENGINEERS IMPROVE THE OHIO RIVER, 1827-1841

The failure of John Bruce to satisfactorily complete his contract in 1827 clearly indicated the project for clearing the rivers of snags would require continuous efforts. The success of the experimental wing-dam near Henderson, Kentucky, also indicated that similar improvements might be accomplished at other obstructive bars on the Ohio. The Corps of Engineers terminated the Bruce contract in 1827, employed Captain Henry Shreve as Superintendent of Western River Improvements, and authorized construction of the necessary floating plant and employment of a hired labor force to continue the project.

Because of the somewhat different requirements of navigation on the Ohio River above and below the Falls, a separate project for the improvement of the Upper Ohio was authorized in 1835. Captain Shreve retained charge of improving the lower river and Captain John Sanders, Corps of Engineers, was appointed as superintendent of the Upper Ohio project. Their operations consisted chiefly of implementing three different but related improvement methods: removing snags and similar obstructions which were the most immediate threat to waterways safety, blasting away rocks to clear tortuous boulder-strewn channels, and constructing simple stone riprap dikes to concentrate water flow over bars and scour away accumulated sand and gravel deposits. In performing these operations, Captain Shreve, Captain Sanders, and their associates developed several novel waterways engineering methods which were still utilized by the Corps of Engineers in the twentieth century.

Rivers and Harbors Act of 1827

A steamboat boom and an increasing

flatboat traffic transported a burgeoning commerce in the Ohio Valley in the 1820s. Steamboat tonnage on the Ohio and Mississippi river systems in 1827 aggregated 25,700 tons, and about 7,000 flatboats of forty-tons capacity each also were navigating the rivers. Approximately 537,000 tons of freight valued at over fifty million dollars were transported on the Ohio-Mississippi waterway in 1827. But nineteen steamboats were lost, chiefly by striking snags, on the rivers in 1827, and about thirty flatboats and their cargoes, valued at \$72,000, went down in the same year. A number of Kentuckians sent a petition to Congress requesting further appropriations for improving the Ohio River navigation. The petition declared:

That they are situated on the Ohio River, one of the chief tributaries of the Mississippi river, some fifteen hundred miles from New Orleans, the great market and depot of all their produce and manufactures, as well as that of the neighboring States situated upon the same river and its tributaries, for more than one thousand miles above us; and all are compelled to send the effects of their labor down the Ohio and Mississippi rivers to market, in the various craft that usually navigate those streams; that these great and navigable rivers are, in many places, obstructed with trees, stumps, and roots of trees, technically called snags, planters, and sawyers, whereby the navigation of them is retarded and rendered very hazardous; and, by them, many of the various craft on the rivers, with valuable cargoes, are annually lost, to the great injury and distress of the adventurers, who frequently embark on board of them, with the effects of their year's labor, and often their all, as well as endangering the lives of the men sailing said craft

On March 3, 1827, Congress appropriated \$30,000 for a continued project for snag removal and for the deepening of the channel of the Ohio at the Grand Chain. It was the first of a series of twelve annual appropriations, averaging \$50,000 per

annum and totaling \$620,000, made from 1827 through 1838 for the improvement of navigation on the Ohio and Mississippi rivers. These appropriations were applied to the removal of snags and other hazardous obstructions and to the improvement of the Grand Chain. Separate appropriations were also made for the construction of wing-dams, or dikes, on the Ohio and for a project for the improvement of the Upper Ohio River above the Falls.²

Snag Clearance Continues

It will be recalled that Captain Henry M. Shreve of Louisville was appointed, December 10, 1826, to succeed Samuel McKee as inspector of the Bruce contract, and the contract was terminated on April 9, 1827, after an unfavorable report by Captain Shreve. Captain Shreve, appointed Superintendent of Western River Improvements at a salary of \$3,000 per annum, continued the clearance of snags and other obstructions from the Lower Ohio and Mississippi rivers with crews of workmen using hand tools and the Bruce machine boats. By the end of 1827 Captain Shreve had cleared the Ohio to its mouth and had worked down the Mississippi to the mouth of the White River, progressing at a rate of about six miles per workday. But he found the work "extremely laborious and somewhat hazardous." Each time a machine boat raised a snag from the river bottom, it was swept off downstream by the current. Shreve turned his attention to the development of an improved machine for raising snags and also concluded that, unless the banks of the rivers were cleared of trees, every succeeding high water would leave the river channels littered with new obstructions.³

The Grand Chain Project

As Superintendent of Western River

Improvements, Captain Shreve was directed to plan a project for the improvement of the Grand Chain of Rocks near the mouth of the river. In support of a specific appropriation for a project at the Grand Chain of Rocks, Congressman Robert P. Henry declared the obstruction "occasioned a greater number of wrecks and the loss of a larger amount of property, than any other on that river." The improvement of navigation at the Grand Chain, he contended, was of great interest to all the states whose commerce was served by the Ohio. The Grand Chain was so hazardous that navigators often employed special pilots to take their vessels through; and, in the early days, a gang of robbers, known as the "boatwreckers," posed as Grand Chain pilots to victimize immigrants and unwary flatboat owners.⁴

Captain Shreve studied the Grand Chain and proposed a channel excavation project. His report explained:

The Chain is about two miles long, extending from fort [Cantonment] Wilkinson down to the Cedar tree, marked on the sketch. The proper time to commence operations on this part of the river would be about the 1st of August; and the necessary preparation for carrying on the work, will be four twin flat-boats, with machinery to raise and carry off the rocks; sledges, crow-bars, blacksmith tools to keep the drills in order; drills for drilling rock, powder, boxes of tin, otherwise canisters ready made for blasting under water, three flat-boats for quarters and store rooms, and subsistence, the whole sufficient to work from sixty to one hundred men.⁵

Shreve warned the date of completion of the project would be uncertain because sickness among the workmen could be expected, recommended that buoys be placed at the head of the Chain for the guidance of navigators, and estimated costs of the project at about \$20,000. General Macomb, Chief Engineer, appointed William Courtney of Pittsburgh, who had

formerly been engaged in the improvement of the Upper Ohio for the state of Pennsylvania, to supervision of the Grand Chain project on May 14, 1827. The General informed Shreve and Courtney that: "As this subject [Grand Chain] is one which has excited much interest among those interested in the navigation of the western waters, it is very desirable that a beneficial result be obtained at an early period" William Courtney was directed to collect equipment and floating plant at Pittsburgh, employ laborers, and descend the Ohio to the Grand Chain, removing snags left by John Bruce, or which had accumulated after the work of Bruce.⁶

During the working seasons of 1829 and 1830 a channel was blasted through the boulders at Grand Chain, some of which were about forty feet long by twenty wide. Some 3375 tons of rock were removed and placed in a wing dam extending from the Illinois shore to direct more water into the channel. The Grand Chain project was completed on November 5, 1830, and increased the available navigable depth through the channel to forty-eight inches — formerly only twenty-two inches had been available at extreme low water. Buoys were installed at the head of the Grand Chain to mark the channel; they were doubtless the first installed for the benefit of navigation on the Ohio and Mississippi river systems. The Secretary of War reported the success of the Grand Chain project to Congress, recommended that appropriations be made for channel excavation and wing-dam construction at other Ohio River shoals, and declared:

At present the imports to the west are mainly through these rivers, and the export trade almost entirely. Usually for six months in the year one of these [Ohio] ceases to be useful, because of the numerous obstructions and consequent hazards which are presented at those times when the waters are materially reduced. The inconvenience

and risk thus felt are susceptible of such easy remedy and at so small an expense, that it becomes a matter of surprise that improvements so important and valuable to a large community should have been so long overlooked or neglected.⁷

Uncle Sam's Toothpullers

While the project at Grand Chain was underway, Captain Shreve planned and built the first steam-powered snag-boat, or the first, as rivermen often called them, of "Uncle Sam's Toothpullers." Such engineers as Major Stephen H. Long, Captain Richard Delafield, and John L. Sullivan had submitted plans for a number of machines designed to utilize the power of steamboats for snag removal to the War Department in 1824, but they had not been adopted. Captain Shreve built a model of a steam-powered snag-boat in 1824, but, though the Corps of Engineers was interested in the invention and offered to "cheerfully defray" the costs of sending it to Washington for testing, Shreve evidently did not enter the contest. Shreve quickly learned that the Bruce machine boat was inadequate for the task, and he concluded that some more efficient method of snag removal was imperative.⁸

Captain Shreve had driving energy, was physically strong, and was possessed of a resolute will, but he was also somewhat reserved, rather eccentric, and short-tempered. His rugged life as a keelboatman and steamboat captain had ill-prepared him for the routine paper work and accounting which the supervision of government projects and disbursement of government funds entailed. He had labor crews — seven contingents in 1830 — working on the Ohio and Mississippi, and he traveled from camp to camp, not often spending much time at his Louisville headquarters completing reports and balancing accounts. He responded to a re-

quest from the Office of the Chief Engineer for more regular reports in 1829 that the department would have to make allowance for the character of his operations:

Each individual who has preceded me in the Superintendency of this work has been disgraced. For myself I undertook it with some confidence of success, but with little prospect of credit to myself. My whole time has been devoted to the service, my Machines for doing the work (which on examination will be found to be entirely new invention well calculated for the execution of that work) have all been furnished from the exertions of my own mind. I have always hoped that I should be able to satisfy my Government and go through with that improvement without fault; how that may terminate time has to test.⁹

Rather than follow the proper channel through the Office of the Chief Engineer and the War Department, the impatient Captain Shreve went directly to members of Congress. In a letter to Congressman Charles A. Wickliffe of Kentucky in 1827, he asked the Congressman and his "Western friends" to obtain further appropriations for continuation of the improvement project on the Ohio and Mississippi and for the construction of a steam-powered snag-boat. Shreve explained: "I am induced to believe that a steam boat can be so constructed as to remove every description of obstructions from the bed of the river, at less than one half the expense that the object can be accomplished in any other possible manner . . ."¹⁰

When Captain Shreve submitted his plans for a steam snag-boat to the Office of the Chief Engineer in late 1827, General Macomb, after review, informed Shreve that there was no doubt of the "superior efficacy" of the steam snag-boat, but construction of such a vessel would be expensive and cost estimates were requested. After receipt of the estimates, the Chief Engineer recommended that the Secre-

tary of War authorize construction of a prototype for experimental purposes, and two days later, on June 27, 1828, authorization was granted and funds immediately forwarded to Captain Shreve.¹¹

Shreve directed the construction of a prototype, at costs of \$26,424.71, at the Zelore & Hines Shipyard of New Albany, Indiana, during the fall and winter of 1828-1829. It was launched on April 28, 1829, rated at 336 tons and drawing six feet of water. Captain Shreve named the vessel the *Heliopolis* for reasons now obscure. It was perhaps named for the ancient Egyptian town of Heliopolis in the Nile Delta, or could possibly be loosely translated as "Crescent City" — New Orleans.

The *Heliopolis* was actually two steamboats with hulls, each one hundred feet long and twelve feet wide, spaced ten feet apart and connected with strong timbers. A timber bulkhead, covered with quarter-inch sheet iron, was mounted between the two hulls near their bows at the waterline. This bulkhead, commonly known as a "snag-beam," was the principle innovation in the design of the boat. Similar vessels had been suggested by other engineers, but they proposed to raise snags with steam-powered windlasses mounted between the hulls. The *Heliopolis* was designed to ram snags head-on, thus bringing to bear the weight of the boat, the power of the engines, and the force of the current to smash snags loose from the riverbed. Snags were then to be raised between the hulls with windlasses and sawed into chunks for use in firing the boilers or other convenient disposal.¹²

Captain Shreve steamed the *Heliopolis* down river at the beginning of the low-water season of 1829, picked up a working crew at Grand Chain, and proceeded to Plum Point, the most snag-infested section of the Mississippi, and began ram-

ming snags out of the river on August 19. He reported that after eleven hours work, all snags on that river section were broken off several feet below the surface of the sand at the bottom of the river, and the vessel had exceeded his "most sanguine expectations." An officer of the Corps of Engineers who later inspected the *Heliopolis* was equally enthusiastic:

No machine can surpass it in its adaptation to the work in the execution of which it is now engaged. The machine is simple in its construction and easy in its application, while in power it has been found adequate to overcome promptly every obstacle it has yet encountered. Through the agency of this machine the largest snags and logs are extracted with ease, many of which, without its intervention, could never have been removed. The value of such an auxiliary cannot be properly estimated, except by comparing its performance with the tardy and expensive mode of removing snags and logs before its invention.¹³

The *Heliopolis* removed 2,061 snags during the first season and was so successful that merchants and steamboat masters of Louisville petitioned Congress for the construction of similar vessels. General Charles Gratiot, Chief Engineer (1828-1838), agreed, and other snag-boats were authorized. The *Archimedes*, a smaller snag-boat, designed to draw less than four feet of water and constructed for about \$12,000 less than the *Heliopolis*, was completed in 1830 at New Albany and joined the first "toothpuller" in clearing the rivers. Six steam snag-boats were constructed while Captain Shreve was in charge of western river improvements. The *Heliopolis* wore out and was replaced with a second boat of the same name; the *Archimedes*, in what must have been an embarrassing moment for Captain Shreve, stove itself while raising a snag in 1836, and was replaced; and the snag-boats *Eradicator* and *Henry M. Shreve* were constructed. All were of similar construc-

tion except the *Eradicator* which had a single hull with a double bow; construction costs averaged \$25,000 each. Snag-boats constructed after Henry Shreve left the Engineer Department were patterned after the *Eradicator* because it had a lighter draft and could more readily work at the lowest water stages when snags were exposed. Captain Shreve also employed about eight small steamboats as auxiliaries to snagging operations and the other projects in his charge.¹⁴

Snag Removal Project

The clearance of snags from the western rivers was not exclusively accomplished by the snag-boats. Captain Shreve planned snagging operations in three phases: first, work crews with hand tools cut away all snags and overhanging trees in island chutes and on sand bars which might endanger navigation at high-water stages; second, the snag-boats removed larger snags from the main channels; third, the snag-boats and working crews returned at low water to remove snags which were newly exposed or newly deposited in the river channels. The project involved immense amounts of manual labor. For example, in October and November, 1830, Captain Shreve and his workmen removed snags from a two mile stretch of the Ohio just below the Louisville and Portland Canal. When sawed to pieces and stacked on the bank for burning, the snags made some 1200 cords of wood. Captain Shreve commonly employed as many as 600 men during working seasons on the Ohio and Mississippi rivers, and snagging projects were soon authorized by Congress for a number of other rivers — the Missouri, the Cumberland, the Arkansas, and the Red River of Louisiana. It was in removing the huge mass of tangled timbers, commonly called the "Great Raft,"



(Copyright © 1970, The R. W. Norton Art Gallery, Shreveport, Louisiana)

Captain Henry M. Shreve clearing the great raft from Red River, 1833-1838

Painting by Lloyd Hawtome (American, 1924-)

which almost completely blocked navigation up the Red River, that Captain Shreve won his greatest laurels. The city of Shreveport, Louisiana, is named for the Captain.¹⁵

Captain Shreve believed the most important phase of his snagging operations was clearing the banks of the rivers of trees which might cave into the water and form new snags. Many rivermen opposed this operation, however, in the belief that the stumps would roll into the rivers as the banks caved and, because they would not be visible to pilots, would form more dangerous obstructions. Objections were so vigorous that clearing the banks was suspended in 1833; but after study of the problem the Office of the Chief Engineer agreed with Captain Shreve that the stumps would sink to the bottom of deeper parts of the channels and create few, if any, additional hazards to navigation.¹⁶

The benefits of the snag removal projects were evident within a short time after work was initiated. Snags were responsible for the great majority of steam boat losses prior to 1827; at the end of fiscal year 1832 Captain Shreve reported that only five steamboats had been lost on the Mississippi during the year, as a result of careless handling, and none at all were lost on the Ohio. Nor had he learned of any losses of flatboats or other watercraft on the Ohio, and he concluded that snags had become a relatively minor risk for steamboats, as compared with fires, boiler explosions, and collisions. By 1835 the number of flatboats insured at Louisville against loss had declined ninety percent from the number insured in 1829, though flatboat commerce had increased during that period; and the insurance companies had reduced premiums on insurance for flatboats by seventy-five percent. Insurance rates on steamboat cargoes also de-

clined fifty percent between 1827 and 1835.¹⁷

Dike Construction on the Lower Ohio

The effects of the wooden-pile wing-dam on the bar below Henderson, Kentucky, in the Ohio had proven that dike construction could be successfully utilized to increase navigable depths over similar obstructions. The stone rip-rap dam completed at the Grand Chain in 1830 confirmed the value of the method; and in 1831 Congress appropriated \$150,000 for the construction of additional dikes on the Ohio, also providing that the projects be supervised by Captain Shreve under the inspection of an officer of the Corps of Engineers. Engineer officers had inspected the projects on the Ohio and Mississippi rivers at various times from 1827 to 1831, but after 1831 a single officer served as inspector.¹⁸

From 1831 to 1834, Captain Richard Delafield, Corps of Engineers, inspected the work of Captain Shreve, furnished technical assistance in dike project planning, and participated in joint surveys with Shreve of various water courses. Captain Delafield was in charge of construction of the National Road across Ohio and Indiana during the same period; he later served twice as Superintendent of West Point, became Chief of Engineers during the Civil War, and designed the castle insignia which have become the symbol of the Corps of Engineers. Lieutenant Alexander Bowman, Corps of Engineers, was inspecting officer from 1834 to 1839, with concurrent responsibility for military road construction in Arkansas. Lieutenant Bowman also served as Superintendent of West Point at a later date, and he became one of the earliest authorities on the use of concrete for construction in the United States.¹⁹



Ohio River — French Island Dike, 1892

Dike construction presented different engineering problems at each project site, requiring detailed hydraulic studies and careful planning before commencement of construction. The engineering expertise and mathematical abilities of the inspecting officers contributed materially to the success of the projects. From 1831 to 1835, Captain Shreve directed the construction of loose stone dikes across secondary channels and longitudinal spur dikes at five shoals on the Lower Ohio between the Falls and the Grand Chain. Stone was quarried near the river bank, transported in scows to the site, and dropped into place along a line laid out during previous surveys. Two spur dikes, over a mile and a half in aggregate length, were completed at French Island; two similar structures at Scuffletown Bars were three-quarters of a mile long; three dikes at Three Sister Islands totaled over a mile in length; and one at Three-Mile Island Bar was about a half mile long. None of these shoals had more than two foot of water over them before work was initiated and navigation was marginal at each; at completion of the projects, all had a minimum navigable depth of four feet.²⁰

Cumberland Island, at the mouth of the Cumberland River, divided the Ohio River into two channels, or chutes. The main channel was down the right chute next to the Illinois bank, because a sand bar in the Kentucky Chute blocked access to Smithland, Kentucky, then an important commercial center and steamboat terminal where Cumberland and Ohio river packets exchanged freight. Downbound vessels took the right channel, circled the toe of Cumberland Island, and turned upstream to reach Smithland or enter the Cumberland. Captain Shreve and Captain Delafield planned a dam connecting the toe of Dog Island with the head of Cum-

berland Island, thus closing the right-hand channel and forcing water down the Kentucky Chute to scour away the sand bar. Rivermen protested the closing of the deeper right-hand channel, and citizens of Smithland feared the project would create currents sufficient to wash away the town wharf. Despite these objections, the project was authorized and, though interrupted by a cholera epidemic among the workmen, Cumberland Dam was completed in 1834. By 1837 Captain Shreve reported that Cumberland Dam, "where so much difficulty existed during the progress of the work, and for which I was so much abused by the boatmen, is now a good channel." Cumberland Dam was repaired and modified on several occasions during the following century, and was still in place and functioning properly in 1971 when ground was broken for Smithland Locks and Dam.²¹

Improvement of the Upper Ohio

After a work force directed by William Courtney cleared the Upper Ohio of snags, as it descended the river in 1828 and 1829, Captain Shreve had confined snagging operations to the Lower Ohio and the Mississippi rivers. The 1831 appropriation for dike construction on the Ohio was applicable to the entire river, but the president of the Louisville and Portland Canal Company requested President Andrew Jackson to direct Captain Shreve to confine operations to the Lower Ohio, explaining:

The commerce and intercourse between the falls of the Ohio and New Orleans is nine to ten times greater, than between Cincinnati and Pittsburgh, the depths of water over the bars and low places, that are to be improved are about the same from Cincinnati to Louisville, as they are from the latter place to the mouth of the Ohio, the removal of a few of the most prominent obstructions below the

falls would permit boats to pass up to the Canal at all stages of water²²

It appears that this argument prevailed, for dike construction was confined to the Lower Ohio until 1835 when Congress appropriated \$50,000 for the improvement of the Upper Ohio. Congress also directed that the Upper Ohio project have its own supervising engineer; and the Chief Engineer appointed Lieutenant George Dutton, Corps of Engineers, as Superintendent of the Improvement of the Upper Ohio River on April 23, 1835. Lieutenant Dutton proceeded to Pittsburgh, acquired a copy of the 1819 survey of the Upper Ohio, and, in September, 1835, examined the river from Pittsburgh to Louisville. He found it much obstructed by snags, rocky shoals, and sand and gravel bars; and he reported that a specific minimum navigable depth could only be established by a lock and dam slackwater system, but considerable improvement could be accomplished by removing snags and rocks, damming secondary channels, and constructing spur dikes at shoals.²³

Lieutenant Dutton put fourteen machine boats, keelboats, scows, and a steamboat to work on the Upper Ohio in 1836 and commenced construction of a dike at Brown's Island between Pittsburgh and Wheeling; the latter was the first permanent structure built by the Corps of Engineers on the Upper Ohio for the benefit of navigation. Lieutenant Dutton was reassigned at the end of the summer of 1836 to duties on the National Road, and on August 31, 1836, Lieutenant (later Captain) John Sanders took charge of the Upper Ohio project.²⁴

Captain John Sanders was, his contemporaries thought, a remarkably original engineer. He invented a steam-powered pile driver and developed mathematical formulas for bearings, driving, and resis-

tance of piles; he developed a mechanical cement mixer and instituted studies of the strength and properties of various cements; he was also one of the earliest advocates of the use of ironclad steamboats, or "floating batteries" as they were originally known. Sanders found the Upper Ohio project quite a challenge, enjoyed life in the Ohio Valley immensely, and while in charge of the project married the daughter of Congressman William Wilkins (Secretary of War, 1844-45) of Pittsburgh.²⁵

Survey of the Upper Ohio

Captain Sanders concluded that rational improvement of the Upper Ohio could be accomplished only if more reliable information about the hydraulic regimen of the stream were available; therefore, he initiated, as he described it, "a survey of the river, comprising a complete hydrographical and topographical survey, giving the bars, channel, and shores; ascertaining the soundings and velocity of the current; and exhibiting every thing necessary for the most judicious location of the dams, and the formation of the best adapted project of improvements." He personally interviewed river pilots and spent uncounted hours wading the river with his survey parties; and his completed survey report constituted an important contribution to the science of fluvial hydraulics, while his maps of the Upper Ohio were not superseded until the twentieth century.²⁶

His survey confirmed the fact that the Upper Ohio was considerably more shallow, had a greater slope, and had more rocky shoals than the lower river. He found that at extreme low water shoals on the Upper Ohio frequently had as little as sixteen inches of water over them; and old rivermen testified that there had been

even less in 1796 and 1819. While the survey was in progress, the lowest water of record occurred on the Upper Ohio in 1838, when as little as twelve inches of water was available on some shoals and steamboat navigation was suspended from July 20 to November 8. Captain Sanders reported the "inconvenience and loss arising from an interrupted navigation of the river has been felt throughout the Union. Large quantities of merchandise destined west, were detained for want of river transportation at Pittsburgh, Wheeling, and Portsmouth and the produce of the country at the points where grown. Travellers had to resort to an expensive land transportation, or await the rising of the river."²⁷

River interests, merchants, and the Falls pilots urged Captain Sanders to take advantage of the extreme low water to remove some of the more dangerous rocks at the Falls of the Ohio; and, after obtaining the approval of the Chief Engineer, the Captain sent Captain John K. Dillingham, a snag-boat pilot who had supervising blasting at the Grand Chain in 1830, to the Falls to employ laborers and start blasting. Louisville rocked as Dillingham blasted day and night. He employed temporary labor, worked the crew of his snag-boat, and acquired the services of convicts from the Indiana State Prison to complete as much work as possible during low water. Rock was blasted out of the Indiana Chute and placed in low dams across secondary channels until the Ohio began to rise on November 7. At a cost of \$1,255.34, Indiana Chute was blasted open to a minimum width of twenty-five feet; and Falls pilots estimated that at least twenty inches more water was available in the Chute when work ended. This emergency project would, Captain Sanders believed, free many watercraft from the "onerous

tax" paid to the Louisville and Portland Canal Company.²⁸

Operations on the Upper Ohio, 1835-1838

In addition to boulder and snag removal, Captain Sanders planned dikes at various shoals designed to increase the minimum navigable depth to thirty inches. There were at least twenty steamboats plying the Upper Ohio in 1835 which drew less than twenty-inches of water. Dike construction was commenced at twelve of the most obstructive shoals, at such sites as Duff's Bar, Petticoat Ripple, Dead Man's Island, Beaver Shoals, Captina Island, and Buffington Island. All were constructed of stone riprap along lines laid out by Captain Sanders. Their size may be illustrated by the dimensions of the dam which closed the back channel at Buffington Island, 215.5 miles below Pittsburgh. It was 2,260 feet long, had a base width of about fifty feet, and was topped off at a height of about six feet above low water.²⁹

For the removal of snags and projecting rocks, Captain Sanders arranged the construction of five Bruce machine boats and organized five working parties of about sixty men each. These worked up and down the river as water stages permitted. In 1837 he also contracted at Louisville for the construction of a steam snag-boat at a cost of \$17,800.05. The snag-boat, named the *Henry M. Shreve* after its inventor, was completed in June, 1837, and began work on the Upper Ohio in August. The *Shreve* later joined the Engineer fleet at work on the Lower Ohio and other waterways. From 1835 to 1839, the Corps of Engineers expended \$180,000 for general channel clearance, \$150,000 for dike construction, and \$17,800.05 for a snag-boat in improving navigation on the Upper Ohio.³⁰

Federal Waterways Policy, 1829-1841

Changes in federal waterways policy were in progress by 1839 which resulted in the temporary suspension of the projects for improving navigation on the Ohio River. Waterways improvement projects, commenced during the Adams-Clay era of economic nationalism, 1824-1829, had been continued during the administration of President Andrew Jackson, 1829-1837. Though President Jackson was to be remembered for his anti-internal improvements policies — Jackson once referred to internal improvements as “this corrupt, log-rolling system of legislation” — his military experience had made him a warm supporter of the Corps of Engineers and he approved of waterways improvement projects on those “great leading and navigable streams from the ocean, and passing through two or more states.” President Jackson vetoed a few bills for waterways projects, notably one which would have funded a project on the Wabash River, but appropriations for the improvement of the Ohio were enacted during every year of his administration and almost seven million dollars were expended on waterways improvements during his administration.³¹

President Martin Van Buren, 1837-1841, like Jackson, disapproved of internal improvements at federal expense, and evidently included projects for waterways navigation in the internal improvement category. During his administration, appropriations for waterways projects ceased and a major reorganization of the Corps of Engineers was effected. The Topographical Engineers had been separated from the Corps of Engineers in 1831 and established as an independent Bureau of the War Department with its own Chief Engineer; and in 1838 the Van Buren administration transferred waterways im-

provement projects to the Topographical Bureau. The improvement of navigation on the inland rivers remained under the supervision of Topographical Engineers until the Civil War, when the two Engineer Corps were amalgamated.³²

Improvement of Ohio River Suspended

The nation experienced its first major economic depression after the Panic of 1837, and federal expenditures were curtailed by the Van Buren administration as an economy measure. No appropriations for the improvement of navigation on the Ohio and Mississippi rivers were enacted by Congress from July 7, 1838, to August 23, 1842, and the projects in progress on the Ohio River, most only partially completed, were suspended.

Captain John Sanders requested an appropriation of \$312,000, including \$5,000 for additional work at the Falls of the Ohio, for the Upper Ohio River in 1839, but Congress took no action on the recommendation. The floating plant for the Upper Ohio project — the *Henry M. Shreve*, machine boats, scows, and a small steamboat — was tied up at Steubenville, Ohio, and in 1840 it was sold at public auction at great loss. Captain Sanders was ordered to New York City, where he participated in fortification construction around the harbor.³³

The last inspection of the work of Captain Shreve on the Lower Ohio and other rivers was conducted by Captain Robert E. Lee, Corps of Engineers, in 1839. Captain Lee and Lieutenant Montgomery C. Meigs had visited Captain Shreve at Louisville in 1837. They were assigned responsibility for the improvement of the Upper Mississippi River and conferred with Shreve about engineering matters. Captain Lee later became commander of Confederate armies; Lieutenant Meigs

became Quartermaster General of the Union Army, Captain Shreve furnished the two Engineer officers with machine boats and a steamboat to inaugurate the improvement of the Upper Mississippi; and Captain Lee also contracted for the construction of a steamboat and stone scows at the New Albany shipyards. On a return trip in 1839, Captain Lee inspected the Lower Ohio project. He reported that Captain Shreve's riprap dams were functioning effectively and recommended that additional dikes be constructed at such sites as Wabash Island Bar, New Albany Bar, and Flint Island Bar, but no appropriations for this work, or for continuation of existing projects on the Ohio River were made in 1839.³⁴

When available funds were exhausted, the snag-boats and other Engineer floating plant were collected at St. Louis for preservation under the care of Captain Shreve until 1841. The Van Buren administration paid the penalty for the national depression in 1840, when William H. Harrison and John Tyler, the Whig ticket, were elected. Captain Henry M. Shreve, a Jacksonian Democrat, was removed from the post of Superintendent of Western River Improvements on September 11, 1841, but it was forty years before the United States settled its account with the Captain. Shreve had taken a patent on the steam snag-boat in 1838, and in 1840 he requested payment for its use:

I must beg leave respectfully to call the attention of the department to my claim for the invention of the snag-boat . . . I see no reason why I should not be paid a fair compensation for the use of that machine by the Government; and therefore hope that some provisions will be made at the approaching session of Congress to do me justice, which is all I ask.³⁵

When Congress again appropriated funds for waterways in 1842 and the En-

gineers returned the snag-boats to service, Captain Shreve sought a court injunction against their use without compensation for his patent, and extensive litigation and congressional investigation ensued. Colonel Stephen H. Long and Major George W. Hughes of the Topographical Engineers and Charles M. Keller, Examiner of Patents, all agreed that Captain Shreve was due some compensation for his invention, but there was disagreement over the amount which would be adequate. Shreve declined to accept \$40,000 on several occasions, contending that his invention, by clearing the Red River of Louisiana of the Great Raft, had increased the value of western public lands by millions, and it had substantially lowered the costs of transporting troops and supplies to the frontiers. The question was not settled in Shreve's lifetime, but Congress eventually appropriated \$50,000 in 1881 for payment to Shreve's estate.³⁶

Captain Shreve made his farm near St. Louis his home after 1841 and invested heavily in the steamboat business. In his last years the old keelboatman and steamboat captain became, perhaps somewhat ironically, a proponent of railroads. Just before his death in 1851, he organized the Pacific Railroad Company which eventually became the Missouri Pacific Railroad.³⁷

Summary

From 1827 through 1838, Congress made annual appropriations for clearing the Ohio and Mississippi river channels of snags and other obstructions. Manual labor, Bruce machine boats, and small steamboats were utilized for the work, but the rapid removal of the obstructions was facilitated by the development of the steam snag-boat. Benefits to waterborne commerce were substantial, as indicated

by the fifty and seventy-five percent reductions in insurance rates on waterways traffic not long after the project was initiated. Snags, which were the major cause of steamboat accidents prior to 1827, were reduced to a minor hazard in comparison with shipboard fires and operational accidents. But new snags were deposited in river channels after every high water, and the Army Engineers recognized that river clearance would necessarily be a continuing project if it were to be effective. Even in the deep slackwater pools on the Ohio and other rivers in 1975, occasional removal of obstructive snags was still necessary.

Separate appropriations for a project on the Upper Ohio River were enacted by Congress from 1835 to 1838, and under the direction of Captain John Sanders the upper river was cleared of its most hazardous obstructions. But on the Upper Ohio, as on the Lower, the major problem for waterborne commerce was not the hazards presented by snags, but the seasonal fluctuations of the river which at times brought practically all waterways traffic to a halt for several months of the year. The successful experiments of Major Long and Captain Shreve at Henderson and Grand Chain proved that economic methods for providing increased navigable depth at the shallowest shoals could be instituted; and in 1831 construction of a few stone dikes at selected shoals on the Lower Ohio was funded, followed by an appropriation for the construction of simi-

lar structures on the Upper Ohio in 1835. The survey of the Ohio River commenced by Captain Sanders in 1837 and the construction of stone dikes contributed materially to knowledge of the hydraulic regimen of the river and lengthened the navigable season somewhat for the light-draft vessels of the era. Stone riprap dams and dikes were constructed by the Louisville Engineer District and other Engineer Districts on the Ohio River until the slackwater lock and dam project was completed in 1929; some were still functioning in 1975, though rapidly disappearing as the deep slackwater pool navigation project progressed.

The burgeoning waterways commerce on the Ohio River during the 1830s necessitated swift and effectual measures to improve navigation, while limited knowledge of the principles of waterways engineering and limited funding presented great difficulties for the Corps of Engineers. The vigor of Captain Henry M. Shreve, the scientific acumen of Captain John Sanders, the expertise of various inspecting Engineer officers, and the herculean labors of the workmen met the immediate exigencies of the situation and improved navigation, insofar as meager funds permitted, in a manner adequate for the needs of the light-draft vessels of the era. Upon this experience and these accomplishments, the Corps of Engineers founded its continuing program of projects to benefit waterways navigation in the Ohio Valley and elsewhere.

CHAPTER VI: INTERMITTENT IMPROVEMENTS, 1841-1861

The constitutionality of waterways improvement projects, like many other important issues of the era, was not resolved during the two decades prior to the onset of the Civil War; and the issue was complicated by the growing sectionalism and political factionalism of the period. Southerners commonly, though not completely, opposed federal waterways projects as unconstitutional extensions of federal powers; Westerners, whose commerce was still transported chiefly by waterways, ordinarily supported federal improvement of inland river navigation; while Easterners often advocated the improvement of seacoast harbors, but gave less than wholehearted support to projects for the inland rivers. Republicans, Free Soilers, Northern Whigs generally advocated the improvement of navigation at federal expense, and Democrats and Southern Whigs were, for the most part, hostile. But sectional origins or political preferences were not always reliable indices to the position a congressman might take on a particular rivers and harbors bill. Local interest in a particular project often took precedence over general political principles.¹

The political and sectional turmoil of the antebellum era made systematic project planning difficult, interrupted important works, and, in short, rendered ineffective the efforts of the Army Engineers to keep the inland rivers navigable. The Engineer program for the improvement of inland waterways became a sporadic affair, according to the political party in power, for federal waterways policies were altered by practically every new national administration from 1841 through 1861. About the only continuity the waterways improvement program had during the era

was provided by Colonel John James Abert, Chief of Topographical Engineers from 1838 to 1861, and Colonel Stephen H. Long, who served intermittently as Superintendent of Western River Improvements from 1843 to 1856. It was a discouraging time for the Army Engineers on the Ohio and other inland rivers — a period of increased interest in railways and declining interest in waterways, of growing waterways commerce and spasmodic waterways appropriations. On the other hand, some promising new concepts in waterways engineering — slackwater projects, reservoir construction, flood control — were first studied in the Ohio Valley during the same era.

Improvement Renewal, 1842

River interests and merchants of Cincinnati met in convention in 1842 to urge upon Congress the necessity for further appropriations for the improvement of western rivers. The convention pointed out, in a petition to Congress, that 450 steamboats, with average cargo capacity of 200 tons, were plying the inland rivers and providing employment for more than fifteen thousand crew members. The petition claimed the work of Captain Shreve and Captain Sanders prior to 1840 had reduced losses due to snags on the inland rivers by three-fourths, declared the West had just as much need for the improvement of its navigable rivers as did the East for improved harbors, and concluded: "We are not aware of the causes which have induced the discontinuance of this valuable service, but we know that the consequences have been disastrous." From 1839 to 1842, one hundred thirty-eight steamboats went down on the inland rivers, with estimated financial losses of a

million dollars annually.²

President John Tyler, who became President at the death of William H. Harrison in 1841, though remembered as a strict-constructionist, states' rights advocate, did approve of a few waterways projects, evidently taking the position of Andrew Jackson that the improvement of major rivers was constitutionally unobjectionable. The importance of such rivers to the prosperity of the nation and the security of the country in time of war could not, in the opinion of President Tyler, be overlooked. On August 23, 1842, Congress provided funds for building and repairing snag-boats and for renewing navigation projects on the Missouri, Mississippi, Ohio, and Arkansas rivers. It was the first of three annual rivers and harbors appropriations.³

After Captain Shreve had been removed by the Tyler administration in 1841, work on the clearance of the Red River Raft had continued by contract with General Thomas T. Williamson, who purchased the snag-boat *Eradicator* for \$8,000. The remaining Engineer fleet became the responsibility of Captain John W. Russell, an experienced steamboat captain and a devout Whig of Frankfort, Kentucky. By 1841 Captain Russell was a near-legendary figure on the western rivers. A Kentucky newspaper commented on his appointment:

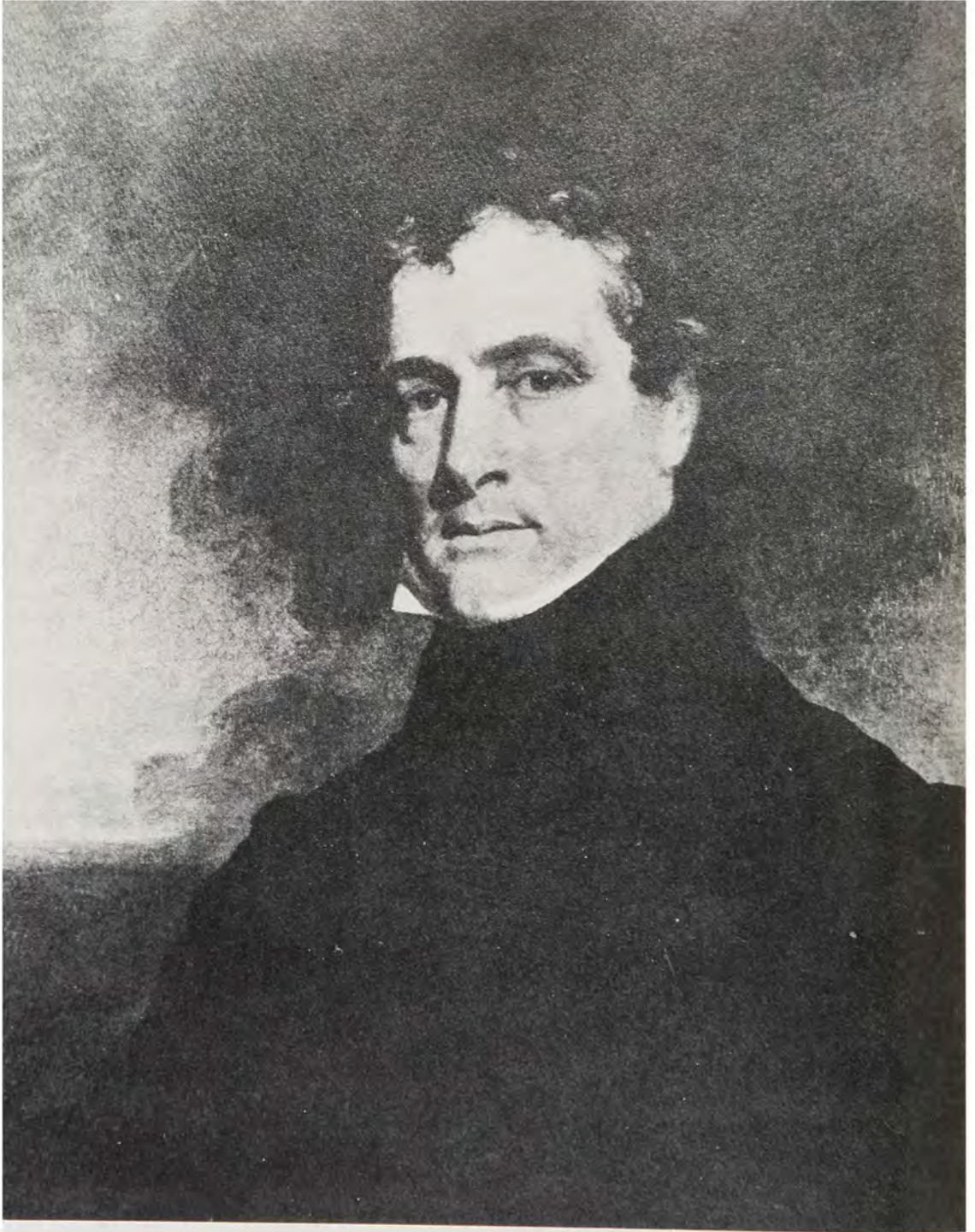
He has followed the river, if we are correctly informed, almost ever since the commencement of steamboat navigation in the West; and, without justifying the removal of Captain Shreve, we have no hesitation in expressing the opinion that Captain Russell is an excellent appointment. As to being obeyed, he can knock down six of the best men in his employment at any time.⁴

Russell was a physical giant who had developed great strength as a flatboat and keelboat navigator. As a steamboat en-

gineer, he once, so it was reported, lifted a 1,647-pound shaft and carried anchors weighing 1,242 pounds across a steamboat deck. Though such claims sound apocryphal, the precise weights lend them some credibility. But Captain Russell achieved his greatest renown when he whipped Jean Lafitte, the pirate, in a brawl in New Orleans, and when he hooked his steamboat to a building at Natchez-Under-the-Hill and dragged it into the Mississippi, threatening to pull in the whole town unless money taken from one of his passengers was returned. (It was returned.)⁵

In 1842 Captain Russell was instructed by Colonel John James Abert, Chief of Topographical Engineers, to prepare the *Heliopolis* and the *Archimedes* for action. He arranged the repair of the two old snag-boats at the Paducah shipyards, and contracted for the construction of two additional "toothpullers," the *Samson* and *Sevier*, for \$20,000 each at New Albany, Indiana. Initial operations were held up by an attempt of Captain Shreve to obtain an injunction against their use without compensation for his patent, but court action was dropped when Congress took up the subject.⁶

In the meantime, the Chief of Topographical Engineers ordered Captain George W. Hughes of the Corps to examine the Ohio and Mississippi and report on the condition of old projects. Hughes employed R. Philip Baker, a former assistant to Colonel Stephen H. Long, secured a skiff at Pittsburgh, and descended the rivers in late 1842. Hughes, who had studied European fluvial engineering extensively, and Baker, who had considerable practical experience on state navigation projects in Tennessee and Kentucky, produced a complex, authoritative report on the Ohio.



(Photo courtesy of Kentucky Historical Society)

CAPTAIN JOHN W. RUSSELL

Their studies indicated that a more radical improvement project for the Ohio might be advisable in the future, but, in view of limited funding, they recommended the renewal of the old river clearance and dike construction projects on the Ohio. Their report was delivered to the new Superintendent of Western River Improvements, Colonel Stephen H. Long, appointed on February 22, 1843.⁷

Activities of Colonel Long, 1843-1845

From 1826, when he completed the experimental wing dam on the Ohio, to 1843, Colonel Long had served as consulting engineer on a number of state projects, such as the project for the improvement of the Tennessee River in 1832, as assigned by the War Department. He engaged in planning and constructing several of the earliest railroads in the United States, and he developed an improved locomotive engine and designed new bridge construction methods. At the time he was reassigned to the improvement of western rivers, he was concluding surveys for railroads for the state of Georgia, during which he had founded "Terminus," which eventually became the city of Atlanta. Colonel Long left Georgia in April, 1843, traveled to Chattanooga, Tennessee, then down the Tennessee River to Paducah, where he joined the snag-boats *Heliopolis* and *Archimedes* on their way to Louisville. Colonel Long established the Office of Western River Improvements at Cincinnati, Ohio, on April 25, leaving the Louisville office to Captain Russell who was directing snag-boat construction.⁸

Some conflict between Colonel Long and Captain Russell over their respective duties ensued, as might be expected from two such colorful personalities, but Russell was a definite asset in handling the rough rivermen of the era. Service on

snag-boats was hazardous; many were seriously injured, or died in the service, while others suffered the ravages of cholera, typhus, influenza, and malaria. In 1843, one crewman of the *Samson* walked off the end of the boat and another was dragged into the river while playing out the windlass, and both drowned. The Chief of Topographical Engineers recommended in 1844 that snag-boat officers and men "employed on duties as exposed, as harardous, and often as fatal, as the vicissitudes of a campaign, should . . . like the wounded and disabled soldier, receive a pension proportioned to the injury he has received."⁹

Colonel Long once reported the "want of due subordination on the part of the crews of all boats;" and, revealing his ascerbic views of human nature, recommended severe penalties for infractions aboard ship. He said:

The propriety of substituting rewards instead of penalties, for the purpose of promoting correct discipline, industry and good behavior . . . is . . . questionable & would probably tend to the subversion of orders and good fellowship on board; for however worthless and inefficient any individual may prove to be, he is generally unwilling to admit, that his services are not equally as valuable & praiseworthy as those of the most industrious . . . ; which the awarding of a compensation to one, greater than that allowed to another, would be likely to engender dissatisfaction, animosities & strife on board . . .¹⁰

The *Heliopolis* and *Archimedes* were worn out by 1845, and Colonel Long sold them. The large twin snag-boat *Hercules* and the light snag-boats *Gopher* and *Dragon* replaced them. The two last-named vessels, designed by Captain John Russell and snag-boat captains John K. Dillingham and Abraham Tyson, were improved versions of the Shreve vessels. Each had a strongly fortified and double-planked single hull, with a "bow transom"

replacing the snag-beam of the Shreve boats. Captain Tyson substituted vertical derricks suspending powerful tackle, mounted on the bow transom, for the wheel and windlass used on the old twin-boats. Instead of ramming snags loose, then pulling them up with the windlass between the hulls, the new boats hooked to snags with the tackle hanging from the derricks and powered by the main water wheel shaft, and forced snags from the bottom by a simultaneous butting and dragging action. The *Gopher* and *Dragon* drew less than thirty-inches of water, were faster than the older boats, were more economical in operation, and were expressly designed for service on the shallow reaches of the upper rivers. Through the use of these vessels and other measures, Colonel Long reduced the cost of removing snags from \$13 per snag, which had been the average cost before 1838, to \$6.54 in 1845.¹¹

*The Return of Captain John Sanders,
1843-1845*

Colonel Abert also dispatched Captain Campbell Graham of the Corps to Pittsburgh in late 1842 to renew the Upper Ohio River project. Captain Graham began an inspection of the condition of the dikes constructed during previous operations, but an effort was made in Congress to secure the appointment of a civilian as superintendent of the project. A petition to Congress signed by many steamboat captains, shippers, and manufacturers thwarted this effort by requesting the return of Captain John Sanders, Corps of Engineers, to the Upper Ohio. Col. Abert of the Topographical Engineers requested Colonel Joseph G. Totten, Chief of the Corps of Engineers, to loan the services of Captain Sanders for the project, because the "valuable experi-

ence acquired by this officer, in his former direction of the same duty, and the known public desire that the work should be pressed forward with much activity renders it a matter of public interest that his services should be obtained." Colonel Totten complied with the request, and Captain Sanders arrived at Pittsburgh in early April, 1843.¹²

Colonel Long was designated inspecting officer of the Upper Ohio project for the Topographical Bureau, and he examined Captain Sanders' renewed operations in May, 1843. The Colonel reported that the Upper Ohio project consisted of:

The construction of wing dams, jetties, &c., having for their object the concentration of the entire low-water volume into a single channel of moderate width, together with the reduction and removal of all bars, rocks, logs, &c., in the way of such a channel, seems to embrace and constitute the only feasible and economical means of improvement that can be applied in this river with a fair prospect of beneficial results.¹³

Chiefly because the improvement of the Ohio River above Louisville became the responsibility of Captain Sanders, Colonel Long was ordered to move the Office of Western River Improvement from Cincinnati to Louisville on April 25, 1844. In early May he arrived at Louisville and occupied an office on Magazine Street between 7th and 8th streets.¹⁴

Captain Sanders employed two assistant civil engineers, Allan Campbell and Charles A. Fuller, to direct the construction of proposed dikes at some seventy islands and shoals on the Upper Ohio, and entered into several contracts for the work. Because the effectiveness of dikes was limited, Captain Sanders spent a great deal of his time developing methods for deepening and widening channels. He divided the Upper Ohio into five sections, each about a hundred miles in length, and assigned a small floating plant and work

force to each section. At high water stages the section gangs cut potential snags from banks and islands, and at low water they removed snags and blasted channels through rocky shoals. Blasting methods were still much like those used on the Louisville and Portland Canal in the 1820s. The men stood in the water to drill holes with hand tools, inserted tin powder-filled canisters in the holes, tamped in clay, and detonated the charges. During the 1843 working season, a work force at Beaver Shoals made 666 blasts, consuming 17 kegs of powder and 1600 feet of fuse in the process, and removed an aggregate of 250 cubic yards of solid rock from the channel. Similar work was accomplished at a number of other shoals on the Upper Ohio.¹⁵

The First Ohio River Dredge

Captain Sanders also initiated a search for mechanical methods of removing compacted sand and gravel formations. The heavy dredges then in use at seacoast harbors were not suitable for the shallower inland rivers, and horse-drawn scrapers were useful only for short periods, when the Ohio was at extreme low-water levels. Contractors on the state project for improving navigation on the Kanawha River had developed a method of scraping bars with horse power. They set two flatboats in place, with piles, on each side of a bar and placed two long parallel timber beams between them. On one boat they installed a capstan that was attached by chains to a scraper between the parallel beams. As horses turned the capstan and wound the chain, the scraper, guided by men walking the beams, was drawn across the bar to loosen and remove the top layer. Repeated use could open a navigable channel across the bar.¹⁶

But the machine was not usable on the

Ohio River, because it would obstruct the constantly passing traffic. Mr. W. Henry McCarty, a "very ingenious man" employed by Captain Sanders, devised a steam-powered scraper somewhat similar to the machine used on the Kanawha. A steam engine, mounted on a boat anchored upstream of the bar to be improved, turned a capstan and pulled a scraper attached to a small boat across the bar. At a cost of \$1500, Captain Sanders constructed the McCarty scraper — the first crude dredge used by the Army Engineers on the Ohio River — and placed it in operation on August 1, 1843. Sanders reported the machine produced the "most beneficial results." In a single day it excavated fifty cubic yards of compacted gravel! And transported it a distance of one hundred feet. Several similar machines were subsequently constructed and placed into operation on the Upper Ohio.¹⁷

Polk Stalks

The Democratic administration of James K. Polk took office in 1845, and President Polk, who contended that federal waterways projects were unconstitutional, vetoed every waterways improvement appropriation enacted by Congress. It was reported that on the eve of the end of his term he went to his office with prepared vetoes in his pocket for any improvement bills which Congress might enact. In 1846, after he vetoed a one and a half million dollar appropriation for waterways, the *Cincinnati Gazette* commented that every snagged boat, every grounded boat, every lost cargo, and each life lost in a steamboat accident would be memorials to James K. Polk. And rivermen began to refer to snags as "Polk stalks."¹⁸

Colonel J. J. Abert, Topographical En-

gineer Chief, continued to publicly advocate federal improvements to navigation, and as a result became very unpopular with the Polk administration. In 1845, Colonel Abert sought to explain the intimate connection between civil works and national defense preparedness:

It is a country that is to be benefited, not a county — a nation that has to be aided, not a town. And all these, by increased facilities of intercourse, by concentrating population, by encouraging agriculture and manufactures, add to national resources, civil and military; give strength, give confidence, give numbers, give wealth, give arms and implements of war, and means of making them; increase national unity, national strength, and add to all elements of national defense.¹⁹

Termination of Waterways Projects, 1845

Captain John Russell, the Whig appointee as agent in charge of snag-boats, was removed from office by the Polk administration on May 31, 1845. His removal was probably in order, for he had actively campaigned for Whig candidates. Captain John Sanders delivered the Engineer fleet and equipment of the Upper Ohio project to Colonel Long at Louisville and departed for Texas to join the army of General Zachary Taylor. One of his assistants, Charles A. Fuller, was employed by Colonel Long, and the other, Allan Campbell, resigned. Colonel Long suspended active projects, sold some of the Engineer fleet, and tied up the remainder for preservation. Some of his assistants and his son, Henry Clay Long, resigned to join the Louisville Legion of the volunteer Kentucky militia, bound for Mexico; and Colonel Long turned his personal attention to the logistical problems of the war.²⁰

The Waterways and the Mexican War, 1846-1848

Captain John Sanders had approached

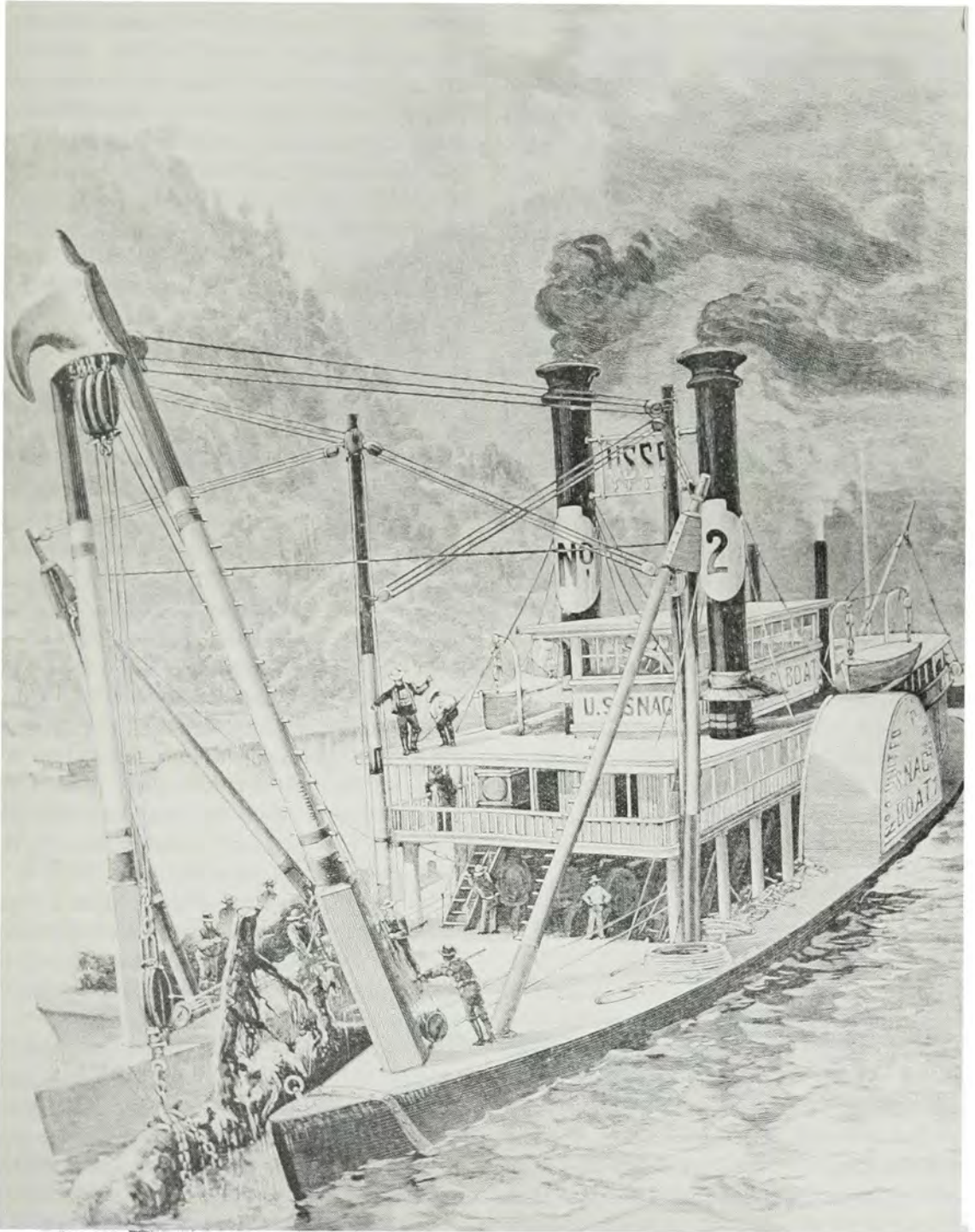
Congressman Richard Hawes of Kentucky and others in 1838 about premobilization contingency planning for the utilization of the watercraft and military resources of the Ohio Valley in case of war along the Gulf Coast, or nearby frontiers. And in 1843 he submitted a report to Congress, recommending the construction of a "fresh water flotilla," a fleet of ironclad steamboats and transports, which could be sent to New Orleans on short notice in a national emergency. He declared that:

The steamboats on all the waters emptying into the Gulf of Mexico, are chiefly built above the falls of the Ohio. In a military point of view, the patriotic statesmen of our republic could have no nobler object than to discover the means of turning, on a sudden emergency, the ordinary industrial pursuits of the country into a war channel. If workshops and ship yards are in the interior of the country, vast expense is saved in preparations for their defence.²¹

Congress took no action on his recommendations, but during the war with Mexico Captain Sanders and Colonel Long were given an opportunity to partially implement such a plan.

General Zachary Taylor ordered Captain Sanders to arrange the supply of the army advancing into Mexico, utilizing steamboat navigation on the Rio Grande. Captain Sanders returned to the Ohio Valley and procured fourteen supply and troop transport steamboats, then returned with them to the Rio Grande and established regular steamboat navigation up the Rio to the supply bases nearest the army. He afterwards rejoined the army outside Monterey, Mexico, and led the combat engineers who cut a passage, literally through the walls and roofs of buildings, for the assault troops who took the city.²²

During the course of the war, the Ohio and Mississippi waterways served as the



U. S. Snagboat No. 2, 1889. Single-hull, double-bow design similar to those constructed by Col. Long at Louisville in 1840s and 1850s. From Harper's Weekly, November 2, 1889.

principal logistic lines for the armies in Mexico. Troops, subsistence supplies, and cavalry mounts moved in a steady stream via the western steamboat down the rivers to New Orleans from port cities and military posts along the Ohio and Upper Mississippi rivers. In September, 1846, Colonel Long transferred the snag-boats *Golpher* and *Dragon* to the Quartermaster Department for use as transports and for clearing the rivers in Texas of snags. In October he received the mission of constructing additional steamboat transports and a steam dredge for the Quartermaster Department for service on the Rio Grande. The steam dredge *Lavaca*, a ladder dredge capable of moving 150 cubic yards of material per hour, was delivered to the Quartermaster Department in 1847. During 1847 and early 1848, Colonel Long arranged the contract construction of six steam vessels for military service. Two, the *General Jessup*, 374 tons, and the *Colonel Hunt*, 200 tons, were built at Louisville for service on the Rio Grande. The other four, built at Louisville and Cincinnati and named the *General Hamer*, *Ann Chase*, *General Butler*, and *Colonel Clay*, were side-wheelers designed for service in the Gulf of Mexico.²³

*Activities of the Louisville Office,
1849-1852*

At the end of the Mexican War, Colonel J. J. Abert modestly summarized its effects on the Engineers: "The peace with Mexico returned to the United States the large proportion of the officers of the corps which had been employed with the army in that country. The greater part of those were maimed with wounds, or sick from the fatigues and exposures which their duties required. Of their services in Mexico it is not necessary that I should speak."²⁴

In 1849 Colonel Long still directed the Office of Western River Improvements at Louisville, but its civil works activities were minimal until 1852. The snag-boats *Samson* and *Sevier* were dismantled at Paducah, and their engines stored aboard the remaining snag-boat, the *Hercules*. C. A. Fuller, Assistant Engineer, was studying the old Cumberland Dam project and planning its repair and modification. Joshua Barney, Assistant Engineer, was conducting yet another survey of the proposed canal on the Indiana bank of the Falls of Ohio.²⁵

Some excitement was created at the Office when young Lieutenant James W. Abert, son of Colonel J. J. Abert, Chief of Topographical Engineers, reported to Louisville as an assistant to Colonel Long. Lieutenant Abert often commenced his official reports to the Chief with the greeting: "My dear father." After arriving at Louisville and finding Colonel Long absent on official business, the Lieutenant had taken an excursion to Cincinnati. When Colonel Long returned to the office he asked the Lieutenant to explain his reason for leaving his post. Abert responded that since his superior was absent, he had become senior officer at the post and had granted himself a leave of absence. Colonel Long had planned to assign Lieutenant Abert to a survey of the Falls of Ohio, but instead wrote the Chief Engineer that, "having nothing special to occupy the attention of Lieut. Abert . . . I see no objection to his being relieved from duty at this station . . ." But Lieutenant Abert eventually adjusted to his duties at Louisville, found them to his liking, married a Louisville belle, and made Louisville his home.²⁶

The principal mission of the Office of Western River Improvements from 1849 to 1852 was the planning and construction

of marine hospitals for western rivermen — a duty assigned to the Office by the Treasury Department. Colonel Long was directed to build hospitals at Louisville and Paducah on the Ohio and at Natchez and Napoleon, Arkansas, on the Mississippi. He disapproved of the Napoleon site because of caving river banks and recommended, instead, a site at Helena, Arkansas. But the Treasury Department ordered construction to proceed and the four hospitals were completed in the 1850s. The one at Napoleon, followed by the entire town, fell into the Mississippi in 1868.²⁷

A Third Beginning, 1852-1853

By 1850 disgruntled western rivermen were vehemently protesting the failure of Congress to appropriate for inland rivers. A river convention met at Evansville, Indiana, in 1850 to petition for appropriations. Its petition claimed that obstructions in the rivers annually produced more losses than all funds previously expended on waterways improvements and caused a greater loss to the West in 1850 than the "whole amount of money expended by the government in keeping up its army or its navy." Though the Whig ticket, Zachary Taylor and Millard Fillmore, which won the election of 1848, approved federal improvement of waterways, Congress had not acted. After succeeding to the presidency on the death of General Taylor in 1850, Millard Fillmore plainly stated his position on federal civil works: "I entertain no doubt of the authority of Congress to make appropriations for leading objects in that class of public works comprising what are usually called works of internal improvement."²⁸

Congress finally voted a major rivers and harbors law in the last year of the Fillmore administration. The Rivers and

Harbors Act of 1852 provided \$150,000 for rebuilding the snag-boat fleet and for its operations and a separate appropriation for dike repair and construction on the Ohio, plus funds for many other projects. The old team of Colonel Long, as Superintendent of Western River Improvements, Charles A. Fuller, as Superintendent of Ohio River Improvements, and Captain John W. Russell, who had been restored to the snag-boat command by the Whig administration in 1852, went back to work, operating out of a four-room office at Louisville. One room was the Colonel's office, another was occupied by Fuller, two clerks occupied the third office, and the fourth served as a drafting and map-preparation room. Captain Russell worked at the New Albany shipyards, where he constructed a steam dredge, the *Gopher*, and a small snag-boat, the *Terror*, for the Ohio River project, and another steam dredge and five light snag-boats (numbered 1-5) for use on other rivers. The *Terror*, commanded by Captain John K. Dillingham, operated chiefly above the Falls of the Ohio; and the dredge *Gopher* did most of its work at the Cumberland Dam project.²⁹

Pierce Punctures the Project

The renewed operations under the appropriations of 1852 were short-lived, for at the end of the year the Democratic candidate, Franklin Pierce, was elected President, and he chose Jefferson Davis (later President of the Confederate government) as his Secretary of War. President Pierce vetoed bill after bill which would have continued waterways projects. Congress enacted five waterways bills over his veto in 1856, but none provided funds for the Ohio River. Secretary of War Davis completely agreed with the

President's position, and recommended that any necessary waterways project be carried out by the states and financed by the states or by the imposition of tonnage duties.³⁰

Captain Russell foresaw what would be his fate. He had been elected by the voters of Franklin and Shelby counties to the Kentucky State Senate, but he sought to retain his position with the Engineers by acquiring the indorsements of forty-six members of Congress, including a few "influential Democrats" of Louisville, and sending them to the Secretary of War. But his services were terminated in August, 1853. Colonel Long kept Russell on the job for a time settle the snag-boat accounts; but when Secretary Davis learned of this action he accused Colonel Long of attempting to protect Captain Russell from dismissal for political reasons and informed the Colonel: "I have determined to relieve you from the Superintendency of the Western Rivers and assign in your place Brevet Lieut. Col. J. E. Johnston." Colonel Long requested a court of inquiry, but the Secretary refused, stating that changes of station ordered by the War Department were not subject to such investigation. On November 1, 1853, Colonel Joseph E. Johnston (later a Confederate General) took charge of the Office of Western River Improvements, and Colonel Long departed for Washington to serve on the Board of Engineers for Lake Harbors and Western Rivers.³¹

New Concepts in Waterways Engineering

As the Engineer program for the improvement of the Ohio and other inland rivers wrecked on the rocks of political principles and political factionalism, a number of able civil engineers were en-

gaged in studies of the applicability of improvement methods, other than snag clearance, channel rectification, and dike construction, to the Ohio. In publicizing results of their studies they launched an engineering controversy which was to continue until 1875 and even into the twentieth century.

The controversy was initiated by Colonel Charles Ellet, Jr., a brilliant young civil engineer who constructed the famed suspension bridge over the Ohio at Wheeling, (West) Virginia. During planning and construction of the bridge, he kept accurate records of river flow at Wheeling for a decade. After study of the records, Ellet calculated the average flow and concluded that a six-foot minimum navigable depth on the Ohio could be maintained by the construction of reservoirs on tributaries to retain flood waters and release them during low-water seasons. Ellet published the results of his hydrographic studies in 1849, acquired a copy of the Sanders map of the Upper Ohio, and proposed that Congress appropriate \$20,000 for surveys of potential reservoir sites. Ellet was so enthused by his idea that he named his son Charles *Rivers* Ellet; he expected to be appointed as engineer in charge of the surveys.³²

A Senate committee recommended that the proposed surveys be funded. Senator Henry Clay of Kentucky was also enthusiastic about the concept; he wrote: "The conviction is strong upon me that this project will ultimately prevail. I think we adopt what nature points out to us by constructing reservoirs to supply a deficiency of water in the channel at certain seasons of the year." And a number of prominent civil engineers, notably Colonel Elwood Morris, were also convinced that Ellet's idea had merit. But the Ellet reservoir system was too advanced

for the limited engineering capabilities of its time. Though reservoirs had been constructed in Europe and the United States, chiefly as feeders for canal systems and for municipal water supply, those Ellet proposed would have required larger dams than ever before constructed, and, like his bridge at Wheeling which fell into the Ohio in 1854, his hydrologic studies had certain flaws.³³

Just as Congress prepared to authorize preliminary studies of reservoir sites in 1857, William Milnor Roberts, a distinguished civil engineer who had studied engineering under Canvass White on the Erie Canal and under Sylvester Welch, Kentucky state engineer, published a critique of Ellet's proposed reservoir system, claiming that costs would be much higher than Ellet anticipated, that land acquisition costs would be prohibitive, that the amount of water storage necessary to aid navigation was underestimated, and that low-flow augmentation and flood control were incompatible project purposes. Milnor Roberts was chief engineer of the slackwater lock and dam, or canalization (i.e., to make like a canal) project completed on the Monongahela River by a private corporation. He pointed out that similarly successful canalization projects had been completed by state governments on the Muskingum, Kentucky, and Green rivers in the Ohio Valley, and recommended the construction of a slackwater canalization project on the Ohio River.³⁴

Roberts also found support in the engineering profession, notably from Josiah Copley of Pittsburgh, who advocated the construction of fifty locks and dams on the Ohio by a private corporation, and Alonzo Livermore, chief engineer of the Green and Barren River slackwater project. Livermore suggested that

Roberts' plan be modified by installing movable chutes in the dams for navigation. Congress, however, was not receptive to a slackwater project. A Senate committee observed that the construction of fifty locks and dams along the course of the Ohio would cost immense sums for both construction and operations, would most likely be swept away by rampant Ohio River floods or be silted up, and concluded that the proposed canalization project would constitute "a very violent interference with the natural laws of navigation."³⁵

Growing discontent with federal inaction led in 1855 to a third proposal for improvement of Ohio River navigation; this from private interests who supported the plans of Herman Haupt of Philadelphia (later Union General in charge of Military Railway construction). Haupt organized a company, chartered by Pennsylvania in 1855, which proposed to construct a two-hundred-foot wide canal down one side of the river, with cross dams and auxiliary reservoirs to furnish the water supply. A Senate committee reported unfavorably on the Haupt plan, commenting that:

The Ohio is a national highway, and no single State can claim jurisdiction over it, or pretend to the right to disturb the flow of its waters, to regulate the transportation or tax the commerce that floats on its surface.³⁶

Enlargement of the Louisville Canal

Other improvement methods were also considered at the Falls of the Ohio during the two decades preceding the Civil War; and Congress authorized studies of the comparative advantages of proposed improvements on several occasions. But Congress also refused to provide funds for any improvement, and the canal corporation finally proceeded with the en-

largement of facilities on its own. Western rivermen continually complained of Congressional neglect of the Falls, and some members of Congress agreed; at least, a House committee reported in 1846:

We keep a fleet in the Mediterranean for the benefit of our commerce in that sea, and we were at great expense to negotiate with the Porte our passage through the Dardanelles; we maintain a fleet in the Pacific to promote our fishing interests in that quarter; we have about forty light houses to illuminate the coast within forty miles around Cape Cod . . . yet have done substantially nothing to give freedom to the navigation of the Ohio falls, which are in the geographical centre of our territory, and are passed by a commerce almost as great as we carry on with all the world.³⁷

A survey of the "best mode" of improving navigation at the Falls was authorized in 1843; and it was completed by Captain Thomas Cram, Topographical Engineers, and Assistant Engineers Allan Campbell and Henry Clay Long (son of Colonel Long) in 1844. The Engineers recommended that the United States purchase the canal, enlarge it, and construct a second canal on the Indiana bank to establish two-way traffic. At the same time, a number of prominent civil engineers, including R. Philip Baker, Kentucky state engineer, and Joshua Barney of Ohio, were advocating the construction of a dam and lock across the Ohio below the Falls to submerge them. The proposal of the Army Engineers was not approved by Congress, and the suggestion of the civil engineers became the butt of much humor. Haldeman's *Directory of Louisville* for 1844 said:

The plan of damming the Ohio river at the Falls, could only find advocates, one would suppose, in the realms of Laputa . . . Slackwater navigation, it is argued may thereby be had, as far up as the mouth of the Kentucky River. Indeed! And sup-

pose we were to raise the dam across the river at the Falls, a foot, or more, higher; why then, of course, we should have slack water navigation a few miles above the mouth of the Kentucky river!

Again, it has been laboriously argued . . . that at some future day, (and long may it be future,) a dam and tunnel will be constructed across the Falls. For all such bold projectors, we earnestly pray that asylums may be assigned, before the small job of damming the Ohio at the Falls, is put up to the highest bidder.³⁸

Cincinnatians, led by Salmon P. Chase, met in 1851 to protest continued federal procrastination at the Falls and the obnoxious high tolls at the Louisville canal. Congress, evidently in response to complaints, provided \$5,000 in the Rivers and Harbors Act of 1852 for another survey; and a Board of Engineers, consisting of Colonel Stephen H. Long, Colonel William Turnbull, and Mr. Charles B. Fisk, conducted the examination in early 1853. The Board proposed that a canal be constructed by the United States on the Indiana bank, but Congress again deferred action.³⁹

In 1857 the Louisville and Portland Canal Company paid for another survey by Colonel Long, who proposed the construction of a larger lock with dimensions adequate for the largest Ohio River steamboat. Armed with the recommendation, the canal company obtained the permission of Congress, on May 4, 1860, to borrow the funds necessary to construct a larger canal and additional, larger locks, provided the company did not pledge the credit of the United States for the redemption of the bonds. And in that year the canal company initiated the construction of an enlarged canal at the Falls, but work was soon interrupted by the economic disruptions of civil war.⁴⁰

The End of an Era

On March 28, 1855, Colonel Long re-

turned to Louisville and relieved Colonel Joseph Johnston as Superintendent of Western River Improvements, but he did not hold the post long, for it was abolished on December 11, 1856. In their last year of operation, 1854, the snag-boats removed some 56,000 obstructions from western rivers; but snag removal was necessary after every high water, and in 1855 eighty-five steamboats went down on the Mississippi River system (twenty on the Ohio). Steamboat commerce increased during the 1850s despite growing railroad competition, lengthy nonnavigable water stages, and unimproved rivers; in 1855 seventy-six steamboats called Louisville their home port and 2,427 steamboats landed at the Falls City. As commerce increased on the obstruction-littered inland rivers, so did the number of accidents. From 1853 to the onset of the Civil War about three thousand Americans lost their lives or were injured in accidents on the western rivers.⁴¹

As he departed Louisville in 1856 for work at the mouth of the Mississippi River, Colonel Long took the opportunity to lecture Congress on its waterways policies and urge a change:

With respect to the adoption of a system of annual appropriations for the prosecution of western river improvements, I conceive there can be no doubt of its propriety and economy. On at least three different occasions, liberal appropriations have been made by Congress for this service, covering the cost of the various kinds of craft, &c., required for the service, and the working of the same for a period limited by the balances remaining for the prosecution of the work after deducting the cost of the craft. In each of the instances alluded to the balance in question was sufficient merely to keep the craft employed . . . two or three years only; after the expiration of which the craft . . . has been sacrificed at public sale . . . In this way nearly one-half of the prime cost of the boats . . . has been virtually wasted. It is believed that the

sacrifices thus incurred may be avoided by adopting the system of appropriation herein suggested . . .⁴²

Work on the Ohio River, however, did not quite end when Colonel Long left Louisville. The Office of Western River Improvements had a balance on hand, after all vouchers were paid, of \$1,148.11. In 1857, two Falls pilots, J. R. Hamilton and Jesse Vansickle, removed the wreck of a steamboat from the Falls and blasted rock from Indiana Chute. With a letter from Colonel Long testifying that their work had materially benefited navigation at the Falls, they applied to the Secretary of War for the unexpended sum in the river improvement account, and it was awarded to them.⁴³

Then, in 1858, Captain James W. Abert returned to Louisville from a military assignment in Kansas Territory. He was ordered to assume charge of operations at Louisville previously under Colonel Long. Unfortunately, the remnants of the Engineer fleet were at work on the Red River Raft under Charles A. Fuller, or under Colonel Long at the mouth of the Mississippi, and no records or equipment of the Office of Western River Improvement remained at Louisville. At the end of fiscal year 1859, Captain Abert reported his operations for the year: "There has nothing transpired worthy of special notice during the past year. This Congress did not appropriate any money to carry on such works as fall under my supervision."⁴⁴

The Secretary of War requested the Chief of Topographical Engineers to explain the nature of Captain Abert's duties, and Colonel J. J. Abert had to admit his son's duties were "very limited." The War Department ordered the Office of Western River Improvement reclosed on February 2, 1860; and Captain Abert was ordered to

Europe to examine the militia system of Switzerland.⁴⁵

Summary

The two decades preceding the Civil War were discouraging years for the proponents of waterways navigation. Steadily increasing railroad competition and extended low-water seasons during the 1850s worried rivermen, and the political complications which prevented effective federal improvements of navigation increased this concern. Each time Colonel Stephen H. Long and the Office of Western River Improvements got projects underway a change in national waterways policies forced suspension of the work and destroyed the integrity of what should have been on-going projects. Because of the increasing amount of traffic and the larger size of the vessels, it even appeared that the navigability of the Ohio and other inland rivers was deteriorating.

On the positive side, the era was marked by developing interest in improving the navigation of the Ohio by more advanced engineering methods — a slackwater, canalization project and reservoir construction. Both methods were eventually to be implemented in the Ohio Valley and elsewhere by the Army Engineers — a canalization project for navigation and reservoir construction chiefly for flood control. And, at the end of the era, the long-awaited enlargement of the Louisville and Portland Canal was commenced. But for Colonel Long and the Army Engineers on the inland rivers the antebellum decades were, in essence, an era of frustration, when their best efforts were negated by national politics. Only after a number of political and constitutional issues were settled could effective improvement of navigation be initiated by the Army Engineers. And those issues were to be settled by the Minié ball and bayonet.

CHAPTER VII: CIVIL WAR ENGINEERING AND NAVIGATION

The Corps of Engineers devoted its primary attention to the performance of its military mission from 1861 to 1865. It was a multifaceted mission, consisting of the planning, tracing, and construction of fortifications, topographic reconnaissance — Civil War battles were often won by those who possessed the best maps — and temporary pontoon bridge and road and railroad construction to facilitate movement of the armies. Union Army Engineers fortified Louisville, Cincinnati, Paducah, Smithland, Cairo, and a number of other port cities in the Lower Ohio Valley; constructed defenses for such inland cities as Frankfort, Bowling Green, and Lexington; built hundreds of feet of temporary pontoon bridging at the Engineer depot at Cincinnati; put down pontoon bridges across rivers — the longest floating bridge ever constructed was completed at Paducah in 1861 — and in general provided full military construction and logistic support for the defense of the Lower Ohio Valley.

Improvement of waterways navigation was neglected in the face of more urgent military functions during the course of the war, but the volume of waterborne commerce on the Ohio River and its tributaries rose to new heights as troops and supplies flowed steadily to the combat theaters. The increased commercial use of the Ohio during the war led, in 1866, to recognition of the need of the Ohio and other inland rivers for further improvement of navigation. The Civil War was for federal waterways policies, as it was for many other aspects of American life, a pivotal event. Before the war the sectional and political divisions of the nation precluded an effective, systematic program of waterways navigation improvement; afterwards, the

constitutionality of federally funded and directed waterways projects was no longer seriously questioned.

Control of the Waterways, 1861

The southwesterly course of the Ohio River formed a tangible extension of the Mason-Dixon line dividing North from South, but the Ohio River and its tributaries also bound the region together as an entity distinctly separate from both North and South. Though the states bordering the Ohio retained their political attachment to the Union during the war, the people of the Ohio Valley, tied commercially to the South by the waterways, were terribly divided at the outbreak of war. West Virginia was still part of the Old Dominion; Kentucky was counted as a Southern state; and many citizens of southern Ohio, Indiana, and Illinois had Southern sympathies. The fact that Kentucky was the birthplace of both Abraham Lincoln and Jefferson Davis provides ample evidence of the reason sentiment in the Bluegrass State was so divided.

Louisville, controlling the Ohio River at the canal and the northern terminus of the Louisville and Nashville Railroad, was a particularly strategic city. Control of Louisville also meant control of most of Kentucky; and had the Confederacy secured Louisville and the state, making the Ohio River its northern boundary, the war could have had an entirely different course, for at the time there are no bridges across the river below Wheeling. Cincinnati, the growing industrial city on the northern bank of the river, was the largest city in the Midwest in 1861, but utilization of its industrial production capability still was dependent on control of the river at that date because it had no rail outlets

south.¹

Thus control of the southern bank of the Ohio and mastery of Ohio Valley waterways were questions of considerable interest, both to the citizens of the Ohio Valley and the opposing governments. Both governments respected the proclaimed neutrality of Kentucky for a time and both hesitated before sealing off the principal trade route, the Mississippi River, between the Ohio Valley and the South. Trade down the Mississippi, though hampered by inspections and some confiscations of cargos, continued until after hostilities had begun.²

At the onset of war, Colonel Stephen H. Long was Chief Engineer of the Topographical Bureau; he was the last to serve in that capacity, for the Corps of Topographical Engineers was amalgamated with the Corps of Engineers in 1863. (Colonel Long retired and General Richard Delafield became Chief of Engineers.) To facilitate planning and construction of gunboats on the Ohio and western rivers, Colonel Long reported in 1861 on available navigable depths. He said that for six months of the year only, a six-foot navigable depth was available on the Lower Ohio up to Louisville; five-foot from Louisville to Wheeling; and four-foot from Wheeling to Pittsburgh, with much lesser depths available on tributary streams. He therefore recommended that the draft of vessels "designed for service in the prosecution of the unhappy civil war with which our once peaceful country is now afflicted" be limited to less than four feet.³

Colonel Joseph G. Totten, Chief Engineer of the Corps of Engineers, conducted a survey of the steamboats which might be available for government service as troop and supply transports, and found that about 250 were plying the Ohio River

in 1861 and an additional 150 were operating out of St. Louis on the Upper Mississippi. Many of them were purchased for government service by the Quartermaster Department; and others contracted at various times during the war to transport war materials. Though the war was marked by extensive use of railroads for military purposes — the Corps of Engineers repaired, built, and tore up hundreds of miles of track during the war — waterways, where available, became the backbone of Union logistics. And in this service many vessels were lost to enemy fire or wrecked on the unimproved rivers.⁴

In late summer, 1861, all pretense of respecting the neutrality of Kentucky and preserving free navigation down the Mississippi was ended. Confederate forces moved into Southern Kentucky and placed a chain across the Mississippi at Columbus; and Union Troops occupied Cairo and Louisville and severed legal trade with the South. During the summer and fall of 1861, several incidents involving Ohio river packets occurred which launched hostilities in the Western theater. A Union gunboat seized the steamboat *W. B. Terry* at Paducah, for instance, in August, 1861, and Confederate-sympathizers at Paducah retaliated by seizing the *Sam Orr* and steaming it up the Tennessee River to Confederate territory, where it was destroyed in 1862.⁵

By the end of 1861 all traffic south of Cairo was suspended, as Union armies prepared to strike south via the Tennessee, Cumberland, and Mississippi rivers. In preparation for this campaign Union authorities had initiated emergency measures to get the necessary floating craft assembled, somewhat on the lines advocated by Captain John Sanders in 1838. Commander John Rogers purchased three large steamboats, the *Conestoga*, the

A. O. Taylor, and the *Lexington*, and converted them into gunboats at the New Albany shipyards in 1861. Gunboat construction at Ohio River shipyards began in earnest in 1862; and by 1865 Cincinnati shipyards alone had turned out fifty-six gunboats. Captain James B. Eads constructed ironclads at St. Louis (Carondelet) shipyards and established a second construction center at Mound City, Illinois, on the Ohio just above Cairo. Colonel Charles Ellet, Jr., the prewar advocate of reservoir construction in the Ohio Valley, constructed and commanded a fleet of "suicide" rams designed to smash the hulls of Confederate boats. They proved effective in action, but Ellet died of wounds received in action at Memphis in 1862, and command of the ram fleet fell to his brother and his son, Charles Rivers Ellet. Ohio River shipyards experienced their greatest construction boom in history and even turned out ocean-going ironclad monitors late in the war.⁶

With this growing fleet, Union armies moved up the Tennessee and Cumberland rivers into the Southern heartland in early 1862 and descended the Mississippi. After a year and a half of continuous action, the Mississippi was again open to New Orleans, the steamboat *Tempest* being the first to reach the Ohio Valley from New Orleans, but waterborne commerce on the Ohio had already revived to meet the logistic needs of the Union armies. By May, 1862, the wharf at Louisville was covered with arriving and departing boats and their cargos. Contractors in Louisville furnished Union armies two hundred head of cattle daily, while Louisville slaughter houses processed a thousand hogs daily. The military supply business had similar effects on commerce at other Ohio River ports. At Evansville, Indiana, for instance, steamboat com-

merce doubled during the war to serve supply businesses which tripled their prewar volume during the conflict.⁷

Action on Ohio Valley Waterways

One objective of Confederate raids into the Ohio Valley was to harass and interrupt logistic support functions. Confederate units obstructed locks on state slack-water projects on tributary streams and often subjected steamboats to rifle and artillery fire. The raids frequently disrupted commerce on tributaries like the Green and Kentucky rivers, and at times caused suspension of traffic on the Lower Ohio. The raid of the Confederate cavalry commanded by John H. Morgan even suspended navigation between Louisville and Cincinnati for a time in 1863; and commerce on the Ohio at Paducah was disrupted in April, 1864, when cavalry commanded by General Nathan B. Forrest sought to capture the city.⁸ Navigation was more seriously hampered, however, on the tributaries which join the Ohio from the south.

Confederate forces which occupied Bowling Green, Kentucky, in 1861 sought to secure the water approach to the city via the Green and Barren rivers by obstructing the state-constructed locks. Union troops rushed up the Green River by boat from Evansville to save Locks and Dams Nos. 1 and 2 (at Spottsville and Rumsey, Kentucky), but Confederates seized Lock and Dam No. 3 (at Rochester, Kentucky). They planned to blow up Lock and Dam No. 3, and holes were drilled in the structure for that purpose, but mill owners at the dam-site asked that their livelihood be not destroyed. A regiment of Mississippi troops refused to participate in the destruction, saying it was not the "kind of warfare they came to Kentucky to wage," and Kentucky and Tennessee troops, di-

rected by W. S. Van Meter, an old Green River steamboat captain of Bowling Green, obstructed the lock with boulders instead of destroying the project. Unionists, however, used the incident as an example of Confederate atrocities. One Union congressman urged the people of the Green River valley to rise en masse against the Confederate "invaders" who destroyed the slackwater project on the Green River "paid for out of your sweat and taxes."⁹

Navigation was restored on the Green and Barren rivers after the Union occupation of Southern Kentucky in early 1862; but in September, 1862, another Confederate unit dumped rock into the lock at Spottsville, Kentucky (No. 1), and throughout the war navigation on the Green was subjected to repeated Confederate attacks. Similar attacks were made on vessels traveling the Kentucky River, where the Commonwealth had another slackwater project in operation, and on other tributary streams. Because of the disruption of war, the locks and dams of the Kentucky state slackwater projects were not maintained, and by the end of hostilities navigation facilities had seriously deteriorated. This was to lead in the postwar era to the formation of private companies for the maintenance of the state projects and eventually to federal control and operation of the old state slackwater projects.¹⁰

Civil War Military Mission

Though waterborne commerce on the Ohio Valley waterways experienced an unprecedented growth during the war to meet the supply needs of Union armies, personnel of the Army Engineers did not conduct operations to improve navigation. Instead they were charged with the performance of various military missions,

consisting chiefly of the procurement and supply of equipment for the combat Engineers, the construction of temporary pontoon bridging for troop movement, the performance of topographic reconnaissance and mapping activities, and the development of extensive fortification systems to protect major military depots, important cities, and rail lines.

At the commencement of hostilities, the United States Army Engineers had only a single battalion of regular Engineer troops; and of the ninety-three Engineer officers in service in 1861 fifteen resigned to join their homes states in the Confederacy. A Confederate Engineer Corps, staffed principally by former United States Engineer officers, was created on March 6, 1861, but it also had limited personnel — ten officers and a company of enlisted men. The Engineers of both armies, who often operated in the vanguard of the armies on reconnaissance missions, suffered heavy casualties, and their number was further reduced by the assignment of experienced Engineer officers to field commands. Such Confederate officers as Robert E. Lee, P. G. T. Beauregard, and Joseph E. Johnston had been United States Engineers prior to the war, and thirty-three Union Generals, including such men as George Meade, Henry Halleck, John Pope, George B. McClellan, and James B. McPherson, had formerly served in the Engineer organization.¹¹

Because of the paucity of trained and experienced military engineers, most engineer troop units and their commanding officers were volunteers with prewar construction and engineering experience on civil works and railroad projects. Behind-the-lines combat support activities were performed, for the most part, by civilian assistant engineers with forces of hired labor under the general direction of a reg-

ular Engineer officer.

Engineer Supply and Procurement

No pontoon bridging equipment was available west of the Appalachians at the outset of war, and furnishing such equipment became a major responsibility of an Engineer supply depot — United States Engineer Agency, Armies of the West — at Cincinnati. But before this agency was established, pontoons were needed on the Lower Ohio. When General Ulysses S. Grant seized Paducah and Smithland at the junctures of the Tennessee and Cumberland rivers with the Ohio in 1861, he determined to construct a bridge across the Ohio to facilitate troop movement and communications. A fleet of thirteen steamboats and 120 coal barges descended from Cincinnati to Paducah, where General Grant's Engineers constructed the longest floating bridge of record.¹²

Just below Paducah (near the present site of Lock and Dam No. 52 and the Irvin Cobb Bridge), Engineers placed coal barges across the Ohio to Tug Island and from the island to the Kentucky bank. A twenty-foot-wide roadway was placed across the barges from bank to bank, with a movable section for passing river traffic and telegraph posts and wire to facilitate communications. The length of the bridge across the main channel was 3,960 feet, and, adding the width of the island and the bridge between it and the Kentucky bank, it totaled nearly a mile in length, a record still unsurpassed in 1975.¹³

Both Union and Confederate armies used wooden pontoons transported in specially constructed wagons during the early stages of the war. A number of "pontoon trains" — pontoons, large wagons, chess planks, stringers, and other equip-

ment — were furnished Union armies by the Engineer depot at Cincinnati. In the last years of war, Union Engineers adopted the canvas-covered, folding pontoon — simply a wooden boat frame over which a heavy canvas hull was stretched. They were light, could be transported in the standard Army supply wagon, and could be quickly assembled by men in the field. Colonel William E. Merrill, chief engineer of the Army of the Cumberland, redesigned the boat frames and added hinges to permit folding in early 1864. This made them even more mobile, and materials for this type of pontoon were procured and assembled by the Cincinnati Engineer depot for use in crossing the many rivers of Georgia and the Carolinas.¹⁴

Other Engineer equipment purchased, assembled, and supplied by the Cincinnati depot included such items as an eighty-wagon tool train loaded with saws, hammers, nails, ropes, and axes for the use of the "Pioneer Brigade" (First United States Veteran Volunteer Engineers) for road and bridge construction ahead of the Union army which moved from Nashville through Chattanooga into Georgia. In 1863 and 1864 the Cincinnati depot furnished a thousand carts, a thousand drays, two thousand sets of mule harness, portable steam saw mills, and immense quantities of lumber for use in fortifying Union supply depots at Nashville, Chattanooga, Louisville, Cincinnati, and elsewhere. The Cincinnati depot also furnished such miscellaneous items as stationary, mapping materials, instruments, and printing equipment for the topographic units performing mapping functions.¹⁵

Fortification Construction

The construction of fortifications at the



(From Harper's Weekly)

Pontoon Bridge at Paducah, Kentucky, 1861

front was ordinarily accomplished by infantry detachments under the supervision of Engineer officers, with the work requiring skilled labor performed by volunteer Engineer units. Behind-the-lines construction was commonly completed by hired and conscripted labor forces under the supervision of civilian assistant engineers who reported to the officer of Engineers in charge of a military department or division. Though Confederate Engineers fortified a few cities in Kentucky in the early phases of the war — notably at Bowling Green — the course of the war after 1862 limited their construction activities to the areas controlled by Confederate armies south of the Ohio Valley.

Some limited fortification construction was completed at Union staging areas, such as Cairo, Illinois; but major activities began when General Grant occupied Paducah and Smithland in September, 1861, and directed his Engineers to prepare defenses for both cities. At Smithland, two earthworks mounting a battery of three large cannon were built; and Paducah was surrounded by a two-mile defensive line of timber abatis and earthworks, with a central redoubt (Fort Anderson) housing a thousand-man garrison and cannon. These fortifications controlled approaches to the towns and navigation on the Cumberland, Tennessee, and Ohio rivers.

Louisville and Cincinnati were first fortified when Confederate forces commanded by General Braxton Bragg and General Edward Kirby Smith advanced into Kentucky and threatened the cities in the autumn of 1862. It appears that one of the major objectives of the Confederate campaign in Kentucky in 1862 was to seize the Louisville and Portland Canal, thereby severing Union logistics via the

Ohio River. One Confederate officer even suggested destroying the Louisville canal so completely that "future travelers would hardly know where it was."¹⁷

As Confederates approached Louisville, thousands of troops were assembled in the city, labor was conscripted, and General William Nelson ordered the construction of a hasty defensive line around the city and the placement of pontoon bridges across the Ohio to facilitate evacuation of the city and logistic support from the Indiana bank if a siege ensued. Two pontoon bridges, built of coal barges — one just below the present site of the Big Four Bridge and the other from Portland to New Albany — were laid down, but the Union Army of the Cumberland, commanded at the time by General Don Carlos Buell, won the race from Tennessee back to Louisville, met the Confederates at the Battle of Perryville, October 8, 1862, and prevented a Confederate assault on the Falls City.¹⁸

With the exception of sporadic raids by Confederate cavalry in force, such as those led by John H. Morgan and Nathan B. Forrest, the major military action of the war in the West was fought south of the Cumberland River after the battle of Perryville, but Union authorities were anxious that such cities as Louisville and Cincinnati, whose capture could be a serious blow to Union morale and destroy the logistic system, be placed in a defensible condition. Colonel James H. Simpson, in command of the Cincinnati Engineer Depot, was assigned responsibility for constructing fortifications around Louisville, Cincinnati, and other vulnerable points in the Ohio Valley. And, because officers of Engineers were rarely available for service at the rear of the armies, Colonel Simpson employed civilian assistant engineers to supervise fortification con-



Wooden pontoon under construction (in Kentucky). 1862. Copy of original drawing printed in *Harper's Weekly*, 1862.

struction.

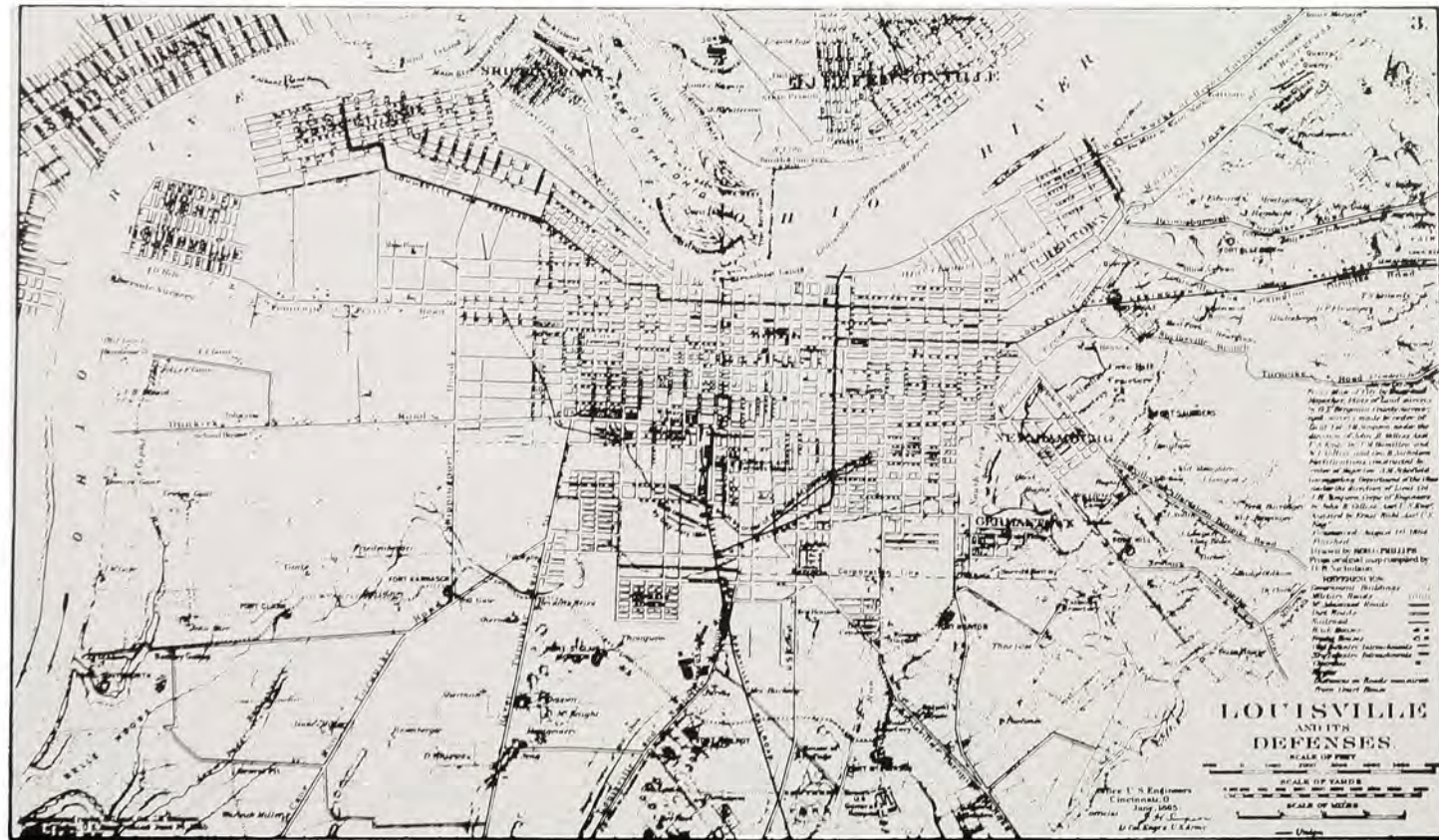
Fortifications constructed during the early phases of the war were often "thrown up" — that is, built of timber and stone masonry with nearly vertical walls. After Engineers observed the effects of increased fire power on such structures, they began to design fortifications which were "dug in" — that is, constructed chiefly of earth and less vulnerable to enemy artillery. Most fortifications completed under the direction of Colonel Simpson in 1864 and 1865 were of the latter type of construction.

Colonel Simpson appointed John R. Gilliss, as assistant engineer in immediate charge of construction at Louisville, and a number of field supervisors, surveyors, and draftsmen. Surveying and drafting were largely the responsibility of George B. Nicholson. Because the assistant engineers thought the five-mile line of intrenchments completed in 1862 too near the city to provide adequate protection from artillery, they made no use of previous work and designed a new fortification system. The first work undertaken was Fort McPherson, commanding the approaches to the city via Shepherdsville Pike, Third Street Road, and the Louisville and Nashville Railroad. Fort McPherson, designed to serve as a citadel if an attack came before the entire system were completed, was an elaborate work large enough to protect a thousand-man garrison. Construction proceeded slowly, until General John B. Hood and a Confederate army marched north from Georgia in August, 1864. It was rumored that General Hood would move into the Ohio Valley, and thus draw General W. T. Sherman and the Union army out of Georgia to defend its logistic lines. The Union command determined, however, not to withdraw from Georgia and to leave the advancing Con-

federate army to Union troops assembling at Nashville under General George H. Thomas. It became imperative, therefore, that Louisville and other Ohio Valley cities be prepared for defense, should the Confederate army get past General Thomas and the troops at Nashville.¹⁹

General Hugh Ewing, Union commander at Louisville, directed that municipal authorities furnish laborers for fortifications, ordered the arrest of all "loafers found about gambling and other disreputable establishments" in the city for construction work, and also assigned military convicts to the work. Eleven forts were hastily constructed to cover the approaches to the city: Fort Elstner on the Brownsboro Pike; Fort Engle, commanding the bridge over Bear Grass Creek, the Frankfort railroad, and Shelbyville Road; Fort Saunders covering Shelbyville and Bardstown pikes; Fort Hill on Newburgh Road; Fort Horton on Shelby Street Road; Fort Philpot on the Nashville Pike; Fort St. Clair Morton, covering Salt River Road and Cane Run Road; Fort Karnasch at the intersection of Cane Run Road and Shippingport Road; Fort Clark to cover Lower Paddy's Run; Fort Southworth on Upper Paddy's Run; and Fort McPherson.²⁰

Each was a basic earth and timber structure surrounded by a ditch with a movable draw-bridge at the entrance to the fort, and each was furnished with an underground magazine to house 200 rounds of artillery shells. These eleven redoubts occupied the most commanding positions around the city, and were positioned to provide an interlocking cross-fire between them. A supply of intrenching tools was also collected and stored for emergency construction of additional batteries and infantry intrenchments between the fortifications. But General Hood and the Confederate army were stopped at the Battle



The Defenses of Louisville

of Nashville in late 1864 and no Confederate force reached Louisville. The guns in the Louisville fortifications were probably never fired, except for salutes.²¹

Other works completed under the supervision of Colonel Simpson included artillery positions and barracks known as Fort Wolfe, for defense of a bridge across Salt River; Fort Boyle, an artillery redoubt and log blockhouse, and Fort Sands, an earthwork with a magazine, on Muldraughs Hill; artillery positions at Munfordsville on the Upper Green River; Forts Lytle and Smith on hills commanding Bowling Green; Fort Boone and New Fort Boone at Frankfort; Fort Robinson at Paris, Kentucky; Fort Clay and Fort Crittenden at Lexington; Fort Hutchinson at Mt. Sterling; Fort Williams at Glasgow; Fort Bishop at Louisa; and several forts at Camp Burnside on the Cumberland River. Around Cincinnati, Ohio, and the cross-river towns of Newport and Covington, twenty artillery positions were built, about nine miles of infantry intrenchments were completed, and Forts Mitchell, Wright, Burnside, and Whittlesey were constructed. In addition, under the direction of Major Miles D. McAlester and Colonel William E. Merrill, both Corps officers, about two hundred fortified timber blockhouses were constructed to defend railroad bridges in Kentucky and on the Louisville and Nashville Railroad and other rail lines transporting large amounts of supplies and reinforcements to Union armies at the front. The blockhouses were constructed to prevent Confederate raiding parties from burning bridges and disrupting Union logistics.²²

Most of these fortifications never saw action, but their existence was an effective deterrent against the surprise assaults by intrepid Confederate commands, which had so embarrassed Union operations and

disrupted supply activities during the early years of the war. Construction of uncompleted projects was halted on May 1, 1865, after the surrender of the Confederate army at Appomattox, but a few were garrisoned by troops during the turbulent years just after the war.

Close of the War

At the end of hostilities, military supply depots in the Ohio Valley, except Jeffersonville Quartermaster Depot at Jeffersonville, Indiana, were closed. The depot at Jeffersonville, established during the war, had procured clothing and other supplies in immense quantities for Union armies, and its operations continued for the supply of troops engaged in frontier Indian wars. Most surplus materials at other depots, including those on hand at the Cincinnati Engineer Depot, were moved to Jeffersonville for storage. Colonel James H. Simpson closed the Cincinnati depot and departed for the frontier where he conducted surveys for the transcontinental railroads then under construction; he took with him his Louisville assistant engineer, John R. Gilliss. Gilliss designed tunnels for the Central Pacific Railroad through the Rockies in 1866, and then returned to New York City where he died in 1870 while constructing one of the first pneumatic tunnels in the United States. George Nicholson, the draftsman at the Louisville fortification project, served as assistant on various Corps rivers and harbors project until 1873, then returned to Cincinnati as engineer on the Cincinnati Southern Railroad — he became Chief Engineer of the line in 1885.²³

Near the end of the war, troop movements on the Ohio River had increased. On January 11, 1865, the XXIII Army Corps was ordered from Tennessee to Virginia. Colonel Lewis B. Parsons, Chief

of Rail and River Transportation, assembled a fleet of forty steamboats at Paducah and moved 20,000 troops and a thousand head of horses and mules up the ice-filled Ohio to Cincinnati, where the journey continued by rail. In seventeen days, the XXIII Corps was transported 1400 miles, about half the distance by steamboat and half by rail, from camps on the Tennessee River to camps on the Potomac.²⁴

On May 15, 1865, Louisville was selected as the mustering-out center for troops from Midwestern and Western states; and on June 4 the headquarters of the Union Armies of the West was established at Louisville. During June, 96,796 troops and 8,896 animals left Washington for the Ohio Valley, via railroad to Parkersburg, West Virginia, where 70,000 took steamboats to Louisville and the remainder embarked for St. Louis and Cincinnati. The Troops boarded 92 steamboats at Parkersburg and descended the river in convoys of eight boats, to the sound of ovations and cannon salutes at every port city. Though the Ohio had less than three feet of water on many of its bars at the time, the voyage was made without loss of life at an average cost of \$3.40 per soldier. For several weeks Louisville was thronged with celebrating soldiers, and on July 4 General W. T. Sherman visited the city to conduct a final inspection of the Armies of the West. By mid-July the Armies of the West were disbanded, and the soldiers on their way home to resume their peace-time pursuits.²⁵

At least 143 steamboats, valued at nearly four million dollars, were lost in government service on the Ohio and Mississippi river systems during the war. And in fiscal year 1866, 262 steamboats were still in government service; but by the end of the year all had been sold. After 1861, the volume of waterborne commerce on the Ohio

had increased each year, and more tolls were collected at the Louisville and Portland Canal in 1866 than in any other year prior to 1872, when the enlarged locks were completed. The waterways of the Ohio and Mississippi valleys had contributed significantly to the success of the military efforts of the Union. And the work of western steamboatmen during the conflict was also an important element of the Union success. Perhaps Colonel Lewis B. Parsons, Chief of Union Rail and River Transportation best summarized this contribution in 1865:

It has often fallen to my lot to witness the cool bravery and acts of daring of this class of men in the passage of batteries or the sudden and unexpected attack of bands of guerillas while navigating our western rivers; and Generals Grant and Sherman, with many others, will bear witness that none have shown greater firmness and resolution in danger or more reckless daring and disregard of personal safety, and I doubt not many of their deeds will live in history. . . . It was by the services of such men that the government was enabled so rapidly to concentrate re-enforcements at Donelson and Shiloh; that with seven days' notice it was enabled to embark forty thousand men under Sherman in mid-winter for the movement against Vicksburg, and subsequently to precipitate the same force upon and capture the post of Arkansas. It was their courage that piloted our transports past the batteries of Island No. 10, Vicksburg, and numberless other places along our western waters; and all who have seen the unblanched cheek and steady arm by which the pilot at the wheel or the captain on the hurricane roof have discharged their duties in hours of danger cannot fail to acknowledge that they justly deserve a page in the history of the events of this war.²⁶

Revival of Federal Waterways Projects

The waterborne commerce generated by the war doubtless had a material influence on the renewed public interest in waterways improvement projects which developed in the postwar era; and there could be no doubt that improvement of

navigation would be beneficial, for between 1866 and 1870 over two thousand people perished in accidents on western rivers. The eclipse of the states' rights segment of the Democratic party in conjunction with the ascendance of the Republican party, which was firmly committed to a federal civil works program, had also opened the way to positive action on needed waterways projects. The constitutionality of federally funded and administered waterways projects was no longer seriously questioned, not even by Democratic Presidents, after the war. Rivers and harbors appropriation bills enacted by Congress in the postwar era were occasionally vetoed and were often criticized for their "pork barrel" provisions, but these objections were based on the expediency, not constitutionality, of appropriation.²⁷

The Rivers and Harbors Act of June 23, 1866, directed the Chief of Engineers to review all prewar waterways projects and plan additional projects of value. It also provided \$550,000 to reestablish the Office of Western River Improvements, build new floating plant, and renew channel clearance projects on the Mississippi, Missouri, Arkansas, and Ohio rivers. General Richard Delafield, Chief of Engineers, completed a quick review of prewar projects and reported to Congress that the benefits of some projects had been substantial, but after the work had been abandoned the quality of navigation had deteriorated and in very few instances had any permanent benefits been secured. He recommended annual appropriations by Congress as "indispensable to obtain the desired object."²⁸

*Office of Western River Improvements,
1866-1870*

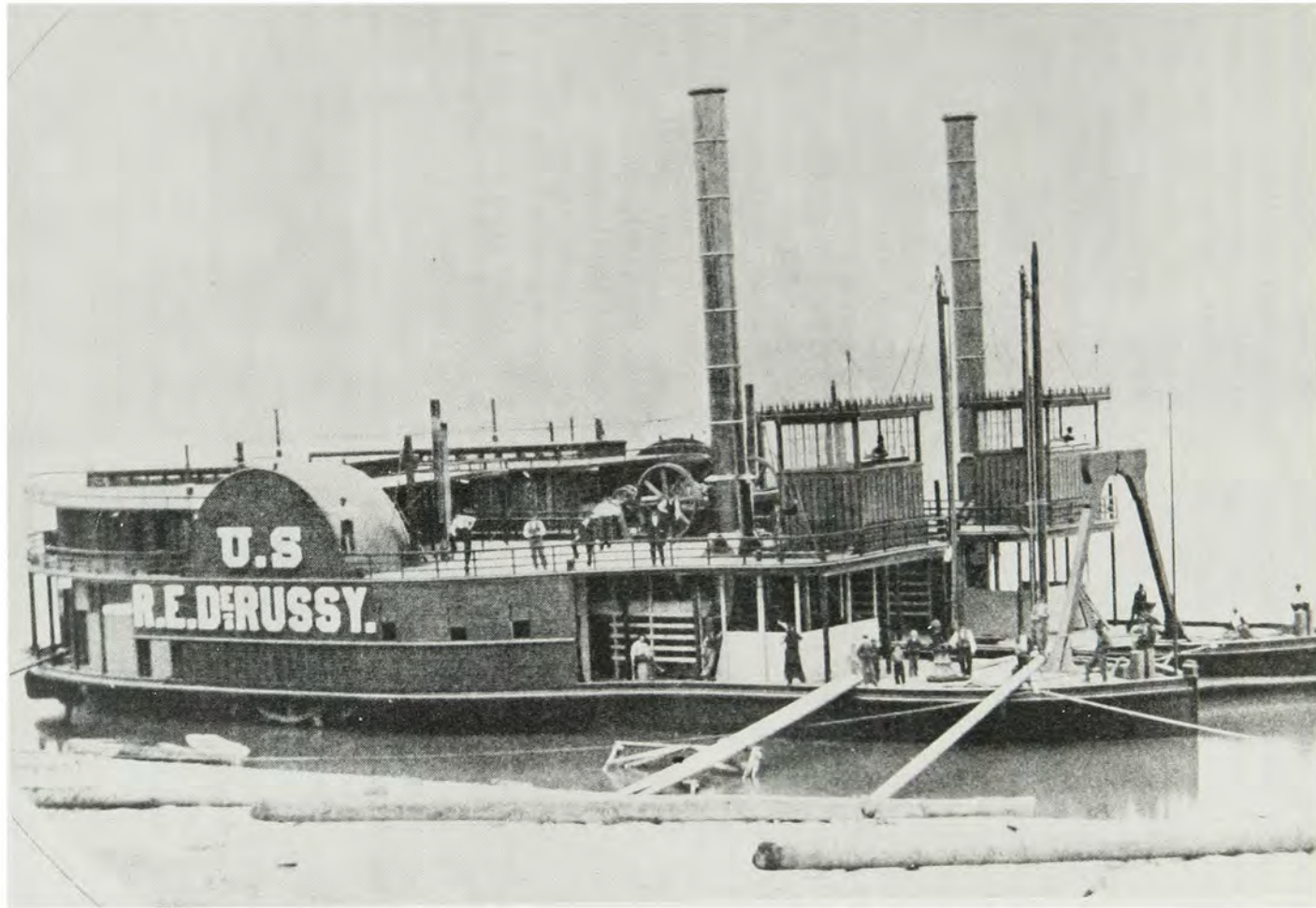
The Office of Western River Improve-

ments was reestablished, with offices at Cincinnati, on August 22, 1866. Colonel John N. Macomb, Corps of Engineers, was appointed Superintendent of the Office, with Major Charles W. Howell as his deputy. Colonel Macomb was doubtless the first officer of the Corps to construct facilities for the Air Force — he had constructed balloon-launching structures for the Balloon Corps of the Army of the Potomac during the Civil War.²⁹

The snag-boats used on prewar projects were gone, and, while Major Howell examined the postwar river channel conditions, Colonel Macomb employed E. M. Shields, an experienced mechanical engineer, and initiated the construction of new floating plant. The steamboat *Commodore* was purchased, renamed the *Gen. J. G. Totten*, and rebuilt at Cincinnati as a wrecking steamer, complete with submarine armor, diving bells, derricks, and electrically-fired underwater torpedoes. The *Totten* was dispatched down the rivers to blow the wrecks, which had accumulated during a decade of neglect and four years of war, out of the channels. After study of previous snag-boats, E. M. Shields made a number of modifications in design, the principal alteration being the installation of six pairs of steam engines, instead of one pair as in earlier vessels. One pair propelled the boats; another set operated the snag-saws; and a third set operated the capstans and chain hoists. This further mechanized snag-boat operations, reduced the size of crews, and effected substantial economies.³⁰

Three new snag-boats were placed under contract in 1867: the *J. J. Abert* and the *S. H. Long* were launched at Cincinnati on December 18, 1867, and two days later the *R. E. DeRussy* slid down the ways at New Albany. Macomb and Shields reverted to the double-hull,





(Office of the Chief of Engineers, Group 77, National Archives)

Two views of the snagboat R. E. De Russy

twin-boat design of Shreve, rather than the single-hull design of Long and Russell, because the boats were destined for service on the Lower Mississippi and the lower courses of tributary streams. Henry Clay Long, son of Colonel Long, inspected their design and reported favorably. The *DeRussy*, as an example, had two hulls, each 150 feet long by 25 feet abeam, and the hulls were spaced 12 feet apart, giving the boat an overall width of 62 feet. In 1869 the Cincinnati office added the snag-boat *S. Thayer* to the fleet and purchased the dredge *Octavia*.³¹

The fleet was constantly at work on the Mississippi and the lower sections of the Missouri, Arkansas, and Ohio rivers, except when repaired and remanned at Mound City and Carondelet (the two ports used for Union ironclad construction and repair during the war); and their operations were attended by the same hazards which had afflicted similar work before the war — the crews and fleet were frequently decimated by disease and accidents. The wrecking boat *J. G. Totten* sank at Chester, Illinois, in late 1867; and in 1868 so many men died of disease on, or deserted, the snag-boat *J. J. Abert* that the captain, William B. Dodson, was forced to run the boat to port at Cairo, and he also died just after bringing the *Abert* to anchor.³²

A separate office for the improvement of the Ohio River was established in 1867, and, except for occasional channel clearance on the Lower Ohio, the Office of Western River Improvement had no further responsibility for the Ohio River project. After the new Engineer floating plant for western rivers was completed and in operation, the Office of Western River Improvements transferred its offices from Cincinnati to St. Louis, effective July 12, 1870.³³

Ohio River Commerce, 1866

Because no Engineer officers were available at the time, General Richard Delafield recommended the appointment of William Milnor Roberts, whom he knew to be an "expert in the improvement of Rivers," as superintendent of the survey of the Ohio River authorized in the Rivers and Harbors Act of 1866; and the Secretary of War appointed Roberts to the post on August 3, 1866. Milnor Roberts was, indeed, an expert waterways engineer. Originally hired by Canvass White as a rodman on the Pennsylvania canal system, Roberts had become assistant to Sylvester Welch on the portage railroad connecting the Pennsylvania canals with the Ohio River. He later served as chief engineer and consultant on a number of the earliest canals and railroads constructed in America, notably on the slack-water project on the Monongahela River which opened the Pittsburgh coal fields to development. It will be recalled that Roberts was one of the earliest advocates of a slack-water project for the Ohio River.³⁴

Roberts had been acquainted with Captain John Sanders and the prewar project on the Upper Ohio. He acquired the Sanders' maps of the upper river, chartered the steamboat *Greenback* (owned by Commander John Rodgers of Civil War fame), employed Thomas P. Roberts, his son and also a capable civil engineer, and George Rowley, an experienced steamboat pilot, and examined the Ohio in September-October, 1866. Thomas P. Roberts and George Rowley updated the Sanders maps during the trip, while Milnor Roberts made observations of the volume and needs of Ohio River commerce and laid plans for a detailed survey and the resumption of open-channel projects.³⁵

Milnor Roberts reported in December, 1866, that at the next low-water season he would continue a detailed survey of the Ohio, beginning where Sanders ended in 1844, would enter into contracts for repair of old dikes and construction of new dikes, and reported the extent of waterborne commerce on the Ohio which would be benefited by renewed work. His report on each port on the Ohio was in considerable detail. At Louisville, for instance, he found 81 steamboats registered with aggregate cargo capacity of 34,079 tons. Between April, 1865, and April, 1866, steamboats landed at Louisville 3,731 times. The Falls City had a population of 125,000 in 1866, had 419 manufactories employing about 8,000 men, and produced goods valued at \$27,517,458 annually. Roberts commented that Louisville, "being the *entrepôt* of a splendid agricultural and commercial region, is destined to be always one of the commanding cities of the interior."³⁶

Roberts concluded the most important development in traffic on the Ohio River was:

The general substitution of fleets of barges for the former single steamers, or the plan of floating boxes. It is reasonable to believe that after a while a large proportion of the steamers engaged in freighting will be tow-boats, running in connection with barges. Some single steamers will of course still be useful in carrying on the local passenger and freight business between the numerous commercial points along the river . . . ; but the bulk of the freighting will probably be ultimately carried on by means of barges towed by steamers.³⁷

Barges were chiefly used in 1866 for transporting coal mined in the Upper Ohio Valley to Cincinnati, Louisville, Memphis, and New Orleans, though some salt, agricultural produce, and manufactured iron were also barged. The Ohio River coal trade had begun about 1814

when coal was sent from mines near Pittsburgh to foundries at Louisville. For about forty years, 1814-1854, coal was carried in coalboats — rectangular wooden vessels resembling flat-boats approximately 100 feet long by 20 feet wide and 6 feet deep. They transported up to 10,000 bushels (330 tons) of coal, were run in pairs, and steered by long sweeps, or oars. Coalboats ran only at high water of seven feet or more at Pittsburgh and were knocked apart and sold as lumber at their destination. They often wrecked on the unimproved rivers, with average losses from each coalboat fleet estimated at ten percent.³⁸

Steamboat operators experimented at an early date with attaching flat and keel-boats to steamboats, and they learned that the most effective method of moving such auxiliary craft was to push them ahead and at the sides of the steamer, guiding them with a "flanking" movement. Barges were first used on the Ohio on a large scale by coal transporters about 1854 between Pittsburgh and Louisville; eventually the practice developed of breaking tows at the "Pumpkin Patch" above the Falls of the Ohio, taking the barges in sections over the Falls, assembling larger tows at Sand Island on the lower side, and proceeding to New Orleans. Milnor Roberts reported that in 1844 two and a half million bushels of coal descended the Ohio in coalboats, and by 1866 ninety steamboats were pushing coal down river and returning empty barges, moving at least forty million bushels of coal annually. In just one week in 1866, seven steamboats arrived at New Orleans from the Ohio Valley with fifty-eight coal barges transporting 45,000 tons of coal worth \$325,000.³⁹

In the opinion of Mr. Roberts, continued growth of the Ohio River coal trade would, in itself, economically justify the

improvement of navigation on the Ohio by "radical" methods; that is, the construction of a lock and dam, slackwater, canalization project. Roberts initiated a detailed survey of the hydrographic and topographic features of the Ohio River in 1867, and in 1870, after intensive study of various engineering methods and their possible application to the Ohio, he recommended officially that the United States undertake the canalization of the river. His recommendation launched a project which, after many delays, was to be completed in 1929, and he thereby earned the sobriquet "Genius of the Ohio River Improvement."

Summary

A booming wartime economy in the Ohio Valley and military use of rivers for troop transport and supply stimulated commercial use of the Ohio and its tributaries which peaked in 1866. The increase in traffic was achieved in spite of prewar government neglect of much-needed navigation improvements and Confederate harrassments during the conflict. In the postwar era railroads gradually absorbed much of the passenger, light-freight, and short-haul business of the packets, but the development of the barge-towing system stimulated use of the waterways for transportation of bulk

commodities and foreshadowed the use made of the rivers in the twentieth century.

During the Civil War the primary mission of the Corps of Engineers was military support and construction, not navigation improvement. Engineer officers, assistant civilian engineers, and combat engineer units operated throughout the Ohio Valley and to the south, performing reconnaissance, fortification construction, and logistic support missions. Most of the major cities of Kentucky were protected by Engineer-constructed fortifications, but the Corps was not authorized to perform any improvements to benefit waterways navigation, the logistic backbone of the Union Armies of the West, on the Ohio and its tributaries.

The national political realignment effected during the course of the war, however, resulted in a renewed federal program of civil works in the postwar era. The Rivers and Harbors Act of 1866 was landmark legislation, which funded a renewed snag-removal project on the Ohio and other western rivers and authorized a comprehensive, detailed survey of navigation on the Ohio River. As supplemented by subsequent legislation, the survey of the Ohio River authorized in 1866 became the foundation for the Ohio River Canalization Project.

CHAPTER VIII: LOUISVILLE CANAL AND DISTRICT, 1860-1900

Captain Henry M. Shreve and Colonel Stephen H. Long managed western river improvements from offices at Louisville for many years before the Civil War, but the history proper of the Louisville Engineer District actually began on May 11, 1867, when an Engineer officer was ordered to Louisville to direct completion of an enlarged canal around the Falls of the Ohio. The authority of this officer and his successors was gradually extended to the Lower Ohio River and tributary streams; and it became the custom to refer to the geographic area of responsibility of this officer and his staff as a "district." After 1888 it became officially the Louisville Engineer District.

The history of the formation and early development of the Louisville Engineer District is of special interest, encompassing several complex developments including final federal assumption of control of the Louisville and Portland Canal, the freeing of Ohio River commerce from tolls, and an extended struggle to free Louisville canal operations of political influences. Many vigorous, colorful officers served as District Engineer during the formative years of the Louisville District, and their utmost ingenuity was required to deal with the complicated engineering and political problems confronting them.

Canal Enlargement, 1860-1866

It will be recalled that Congress authorized the Louisville and Portland Canal Company to borrow funds necessary to enlarge the canal on May 4, 1860, but, though the United States owned all but five shares of company stock, Congress was not prepared to assume any responsibility for the work. A convention of

steamboat interests had met at Louisville in 1859, and at that convention Theodore R. Scowden, a hydraulic engineer who constructed water supply systems for Cincinnati and Cleveland, Ohio, and Louisville and Newport, Kentucky, presented a plan for enlargement of the canal and construction of additional locks that was endorsed by the convention. The canal corporation sold bonds to finance the project, employed Theodore Scowden as engineer, and initiated construction.¹

Plans called for a ninety-foot wide canal, with two basins to permit boats to pass, and construction of the largest lock in the world at the time — a two-flight lock with a total lift of 26 feet and each chamber 80 feet wide and 350 feet long. The new lock was laid out in a new branch of the canal excavated from the head of the old lock in a southerly direction to enter the river a few hundred feet below the outlet of the old canal. The cornerstone of the new lock was laid on April 2, 1862; stone for the masonry was quarried 120 miles down river and transported to the site. The last stone in the massive masonry lock walls was set in place on October 18, 1865, after three-years construction, and canal excavation was about seventy-five percent completed by that date. An iron swing-bridge across the lock was completed; timber and iron for the lock-gates were stored in a warehouse ready for assembly. But, after an expenditure of \$1,825,000, the project was suspended because the inflationary economy of the war had so increased the costs of labor and materials that the company simply did not have the financial reserves necessary to complete it.²

Shipping interests of the Upper Ohio Valley were outraged by the delays of

construction and suspension of the project. A delegation from Cincinnati was reported as saying: "And now the question recurs with awful significance, how are we going to get past Louisville? There are no balloons that we know of. There is no money in Kentucky that we ever heard of. If we don't finish that canal in some way, we may as well return to wheelbarrows." Perhaps a Congressman from Cincinnati best expressed the prevailing sentiment on the subject of the canal in the postwar years:

Slavery is now abolished, the war is over, and considerations of patriotism and interest alike demand that we should address ourselves to the task of repairing the losses incurred and building up the places made desolate by the ravages of war. To that end we should encourage every work which tends to make communications between the two great sections of the country, lately estranged, free, and safe. Improve this canal, then, and make it free to the commerce of the valleys of the Ohio and Mississippi. Commerce is the great civilizer, it is the great agency of peace and prosperity.³

Government Surveys, 1866-1868

W. Milnor Roberts inspected the Louisville canal during his preliminary examination of the Ohio River in 1866. He estimated that, though lock masonry was completed, the enlargement project would cost another million dollars to complete. He declared, however, that speedy completion of the project was vital to Ohio and Mississippi valley commercial interests and recommended that the United States "take this important work in hand and complete it at the earliest period possible, under some arrangement that would be satisfactory to all parties concerned."⁴

Congress responded to this recommendation and to general public concern with a provision in the Rivers and Harbors Act of March 29, 1867, for a survey of a canal route on the Indiana bank and comparison

of its costs with those of completing the Louisville canal. The Chief of Engineers collected previous survey reports of Thomas Cram, 1844, Stephen H. Long, 1849, and the Board of Engineers, 1853, delivered them to Major General Godfrey Weitzel, and ordered him, on May 11, 1867, to Louisville to complete the authorized survey.⁵

General Weitzel was a Cincinnati Rhinelander, born in Germany and characterized by an almost brutal honesty. Before the Civil War he constructed fortifications for the Engineers, and during the war took a commission in the volunteer army, rising to the command of a corps of the Army of the James. General Weitzel and his command had the honor of being the first Union forces in Richmond in April, 1865; and General Weitzel had taken President Lincoln on his famous tour of the home of Jefferson Davis and Libby Prison while Richmond was still aflame. After the war, Weitzel served on the Texas border with the troops who served notice of eviction on the French in Mexico, and then returned to the Corps of Engineers, reverting to his regular rank of Major, though he was ever afterwards addressed by his volunteer rank.⁶

The political sensitivity of Congress and the Chief of Engineers in handling the controversial Falls of the Ohio project should be recognized. Congress authorized *first* a survey of a canal route on the Indiana bank — considerable public support for such a project still existed in 1867 — and then comparison of its costs with those of completing the Louisville canal. And the Chief of Engineers appointed a famous *Cincinnatian* to direct the survey of the canal at Louisville and report its results.

General Weitzel traveled to Louisville, employed assistant engineers, surveyors,

and a chief draftsman named Colonel Philip J. Schopp. In July, 1867, Weitzel instructed his staff to survey first the proposed Indiana canal, then the riverbed of the Falls, and finally the Louisville canal. He traveled to a river convention at Cincinnati in October, solicited the opinions of the delegates on the Falls project, and took a vote on the best dimensions for locks at the new canal. The convention voted for locks 400 feet long and 110 feet wide, if a canal were constructed on the Indiana bank, but it recommended that the new two-flight lock at the Louisville canal, with chambers 350 by 80 feet, be first completed.⁷

At completion of surveys in 1868, General Weitzel submitted an elaborate report to Congress, stating it was his "positive conviction" that the entire Ohio River would eventually be improved and chiding Congress for neglecting the improvement of an "insurmountable obstruction," the Falls, across a national highway. "It was clearly the duty of the government to remove this obstruction," he said, "as it did and does almost everywhere else on the Atlantic coast and northern lakes; but instead of doing this duty, it became a stockholder, and made money in a company chartered by the State of Kentucky, which levied an onerous and unjust tax on the commerce of the country."⁸

General Weitzel estimated that, because of the limited size of the existing canal at the Falls, the United States had paid for transshipment of government freight around the Falls during the war a sum which would easily have paid for an entirely new canal. He had received the assurance of the canal directors that they would gladly sell their five shares at a hundred dollars per share and surrender all rights to the canal to the United States, providing the United States would also as-

sume responsibility for payment of all bonds and debts of the company. General Weitzel recommended that Congress accept this offer, complete the Louisville canal, and also construct a second canal on the Indiana bank to accommodate growing river traffic.⁹

Completion of the Enlarged Canal, 1869-1872

Congress avoided the issue of control of the Louisville canal, but on July 25, 1868, appropriated \$450,000 "toward completing the Louisville and Portland canal, in accordance with the plans and estimates made in the report of General Godfrey Weitzel." General Weitzel employed assistant engineers and a work force and launched a project to complete excavation of the canal, build masonry walls along the canal slope, assemble and install lock gates, install miter sills on the bottom of the lock chambers for the gates to lap against in closed position, and construct a guide wall (apron dam) at the head of the canal to facilitate the safe entrance of watercraft.¹⁰

Construction was delayed by frequent strikes by the workmen and by irregular appropriations — General Weitzel commented that had funds been provided in a more business-like manner the work could have been completed for \$100,000 less — but was otherwise free of incident until the date it was to open to traffic. At 7:30 p. m., November 22, 1871, the last rock was excavated from the canal; and at 8:00 a. m., November 23, traffic began to enter the new branch. But suddenly the miter-sills gave way and the lock-gates began to break loose from the walls under the strain. Weitzel closed the canal and labored three days and nights throwing a temporary cofferdam across the canal. Weitzel later explained that on the day be-



(Photo courtesy of the Cincinnati Historical Society)
MAJOR GENERAL GODFREY WEITZEL

fore opening the canal he inspected the gates and found the timber cushions along the miter sills lacked an inch of meeting and sealing the bottom of the gates. He directed the contractor to replace the timber cushions and it was done with lumber from the warehouse which had been stored for eight years. The General concluded that after water entered the lock the seasoned lumber in the cushions became saturated, expanded, and the resultant stress forced the miter sills out of position. He lamented to the Chief of Engineers:

I wrote to Mr. Milnor Roberts, and he sent me two assistants of experience, and I have read every work I could reach on the subject of locks, even sending to Europe for two works, at a large expense. But the trouble is that no locks were probably ever built, where the gates are put together eight years after all their parts are framed, and all this assistance and information, to me thus gained, was of no practical value in this instance.¹¹

Two-inch bolts to anchor the sills to the rock foundation were installed; calking was added between the timber cushions and stone miter-sills; additional braces and "hog-chains" were installed to strengthen the huge lock-gates; and on February 26, 1872, the steamboat *Mollie Ebert*, followed by the *E. H. Durfee*, *Esperanza*, and *Potomac* locked through. The *Courier-Journal* reported that Louisvillians rejoiced at the opening of the enlarged canal and locks and fully supported the removal of tolls for its use at an early date.¹²

Freeing the Canal, 1872-1880

In 42 years, 1831-1872, the Louisville and Portland Canal Company collected tolls substantially in excess of five million dollars. Receipts were \$180,925.40 in 1866, (the highest amount collected on the old canal and lock), were \$159,838.90 in

1871, and increased to \$207,025.19 in 1872, the year the enlarged canal completed with federal funds opened. Congress was finally prepared to extend the jurisdiction of the United States to the Louisville canal, and in the Rivers and Harbors Act of June 10, 1872, it provided \$300,000 for further improvements at the canal and directed the Secretary of War to report the steps necessary to free Ohio River commerce at the canal, except for a five-cent per ton toll to fund continued operation and maintenance.¹³

General Weitzel informed the directors of the canal corporation of the terms of the act, but a legal snarl ensued. The directors informed the General that the United States had no power to fix tolls and the company would not permit continued work on the canal project with the \$300,000 appropriation, if it were contingent upon reduction of tolls to five-cents per ton, which would be insufficient to retire the bonds of the company. Weitzel replied that suspending work at the canal would do great injury to the commerce of the United States and informed the directors: "As the representative of the people, I consider it my duty to guard against any such consequences, and I will therefore carry on the work until I am ordered by my superiors to stop; and I request that you do not interfere until I can hear from them."¹⁴

The corporation was uncertain of the proper procedures for bringing suit against the United States; therefore it determined to force the issue. When General Weitzel renewed work on a landfill section at the project site, the company sent its dredge to the scene and as fast as the Engineers put earth in the fill the dredge-boat picked it up and threw it back. Weitzel was forced to take court action to obtain the privilege of expending



(Record group 77, National Archives)

Louisville and Portland Canal—New locks under construction, 1871

the \$300,000 appropriation for the canal. Rivermen and commercial interests were outraged by the delay at the project, for their boats and freight ran daily risks in passing the canal. One letter, for instance, in the *Courier-Journal* contended:

The principal source of difficulty between Gen. Weitzel and the Canal Company consists in this: that the latter look at the matter entirely from the technical stand-point of the lawyer, and for the time being have abdicated the use of their common sense. As for lawyers, they nearly always make matters worse. What with their subtleties, their quibbling, hair-splitting constructions, their fanatical regard for formulas, and their love for time-consuming processes, everything goes slow, and wrong, and injuriously the moment you have to place it in a lawyer's hand.¹⁵

But, to the credit of government attorneys and counsel for the company, in this instance action was swift. The case was taken immediately before a Justice of the Supreme Court of the United States, who granted an injunction against further interference by the company with the project and declared that the United States could not fix the amount of tolls until it had full control of the canal. Congress directed on March 3, 1873, that the Secretary of Treasury purchase the remaining stock of the company in private hands, assume full control of the canal for the United States, and reduce tolls immediately to twenty-five cents per ton. But the directors still refused to surrender the company charter till Congress legally assumed responsibility for the bonds and debts of the company. Congress assumed this obligation on May 11, 1874; and on June 10, 1874, at midnight, the United States took over the Louisville and Portland Canal. Shortly thereafter a boat passed through at reduced toll-rates, thus accomplishing, said General Weitzel, "a thing which the people of the West have been endeavoring to effect during the last thirty-four years."¹⁶

As the Engineer staff at the canal improved the efficiency of canal operation and maintenance, tolls were further reduced, but in 1880 a nominal toll was still being collected. The House Committee on Railways and Canals reported a bill in 1880 to remove all tolls, and it commented:

The treaty of Paris, negotiated in 1783; the treaty with Spain negotiated in 1795; the ordinance of 1787, and many subsequent acts of Congress, provide for the absolute freedom of the Mississippi River and its tributaries, and dedicate them to the world as great national highways, to be kept forever free from any toll, tax, or duty of any kind whatever These various treaties, reports, acts, and official declarations clearly indicate that for nearly half a century it has been the desire and intent of the government to secure the free navigation of the Ohio at this point.¹⁷

On May 18, 1880, Congress directed that no further tolls be collected at the Louisville canal after midnight, July 1, 1880, and that operation and maintenance costs were to be paid from Treasury funds. Strange to say, there was little public reaction to the final end to tolls. Will S. Hays, the wit, balladeer — author of many familiar lyrics, such as those of "Dixie" — and river news reporter for the *Courier-Journal*, probably summed up the reaction of rivermen: "Now as the canal is free, why can not wharfage be made free? There is no reasonable excuse in the world why the wharfage should not be free. Steamboats should at least have the same free privileges that our 'big-hearted city' gives to railroads."¹⁸

The steamboatmen had moved from the canal tolls to other increasing problems, and General Weitzel also had new problems. He wrote in confidence to a friend in early 1881:

The way of lawyers are truly wonderful. Congress passes a law and the President signs it saying that the canal at Louisville shall be operated and

kept in repair by making monthly drafts on the Treasury.

The First Comptroller of the Treasury, after thinking over the matter about six months, says that the law makes no appropriation for operating or keeping the canal in repair. The same law directs the Canal to be free after midnight July 1, 1880.

If this decision of the First Comptroller stands as sound, and Congress does not correct the matter, I am personally liable for the whole \$17933.22 which I have so far expended.

The wisdom of some of our Solons passeth my understanding.¹⁹

Congress, however, did not leave General Weitzel out on the proverbial limb. It provided funding arrangements in the Rivers and Harbors Act of 1881 for continued operation of the canal.

Canal Administration

At completion of the canal enlargement project in 1872 General Weitzel had been ordered to Michigan to direct a similar project at the St. Mary's Falls Canal, but he retained overall responsibility for the Louisville canal, with a deputy, Captain Milton B. Adams, Corps of Engineers, in immediate charge. Weitzel recommended in 1873 that when the United States took over operation of the Louisville canal, "the persons should all be employed during good behavior, for it will work serious if not fatal injury to the best interests of commerce if experienced men are not continually employed on the work especially in opening and closing these enormous gates." He was given authority to appoint the Louisville canal staff in 1874, and he retained most of the company personnel previously employed and selected his assistant, Colonel Philip J. Schopp, as superintendent. Captain Adams, deputy to General Weitzel at the canal, was relieved by Captain Alexander Mackenzie (later Major General and Chief of Engineers, 1905-1908) at the end of July, 1874; Cap-

tain Mackenzie had immediate charge of the canal until November 22, 1877, when relieved by Captain A. Nesbitt Lee, who died of a stroke at the project on October 31, 1879. Because no junior officer was then available for assignment, Superintendent Philip J. Schopp was assigned full responsibility for the canal under General Weitzel's orders.²⁰

Dam at the Falls

In his report on the improvement of the Falls of the Ohio in 1868, General Weitzel recommended construction of a dam across the Falls to increase the depth of Louisville harbor three feet, prevent boats from wrecking on the Falls when seeking to enter the canal, increase water depth in the canal, and, through an opening in the dam at the head of Indiana Chute, increase the navigable depth for traffic passing over the Falls instead of through the canal. A timber-crib, stone-filled dam — that is, large timber boxes, similar in construction to a log-cabin, securely bolted at the corners and filled with irregular run-of-the-quarry stones — was authorized and placed under construction in 1868. In 1870 an apron dam, running north from the entrance of the canal and serving as a guide wall, was complete and about a third of the cross-river dam was in place. But construction was constantly interrupted by high water and runaway barges. For example, a barge rammed the cofferdam protecting the work area in 1875, destroyed a hundred feet of the coffer and flooded the work. By the time the cofferdam was repaired the river was rising and no further work could be undertaken until the following year.²¹

The cross-river dam was completed in 1881; 2,532 feet long from the head of the canal to the Indiana Chute and 210 feet from the Indiana Chute to the bank on the

Indiana side. Rock was blasted from the Indiana Chute to facilitate navigation and plans were instituted to install a movable metal Boulé navigable pass to close the Chute at low water and collapse against the bottom of the river at high-water to permit open-channel navigation. Numerous modifications, as experience indicated, were made in the dam across the Falls until the early twentieth century, when planning to construct a new dam at the Falls as part of the Ohio River Canalization project (it became Dam No. 41) was initiated.²²

Canal Operation

In 1874 the Louisville project consisted of a canal about two miles long and eighty-five feet wide, with two basins for boats to pass when in the canal. It had two sets of locks in two different outlets at the lower end of the canal. In addition, a dam was under construction across the crest of the Falls to provide better navigation through the Indiana Chute. The old lock, completed in 1830, was a three-flight structure, with an eight and two-third foot lift in each of the three chambers; and the new lock, completed in 1872, was two-flight, with a fourteen-foot lift in one chamber and twelve in the other. Because the locks were built in flights, like stair-steps, without intermediary basins, each boat has to pass through the entire series of three or two chambers before another could enter, and navigation, consequently, suffered many delays. General Weitzel said in 1879:

The chambers of the new locks of the Louisville and Portland canal are 372 feet long and 80 feet wide. There are two lifts of 14 and 12 feet. The gates are very heavy. One leaf of the middle gates weighs over 90 tons. The machinery for operating the gates is worked by hand. Yet we have made 29 lockages in 21¼ hours.²³

Lockhands at the Louisville canal necessarily had strong legs and backs, for the gates were opened and closed by turning capstans attached to the gates by chains. Lockhands seized handles extending from the capstans and walked and pushed in circles to wind the chains on the capstans. In 1876 they opened and closed the gates 8,406 times for 1,401 lockages. In turning the capstans and walking from gate to gate, each lockman walked about 2,604.85 miles during the year, or an average of 7.14 miles per day. It required five hours, forty-five minutes to pass the steamboat *Sam Brown* and its tow of sixteen coal barges through in six sections on December 3, 1875. On May 27, 1876, the lock force moved four steamboats and forty-six barges transporting 800,000 bushels of coal through the locks, which was just about the peak of human capability. As many as five coal tows with up to twenty barges each were frequently waiting at the canal for lockage, and problems naturally ensued.²⁴

Each steamboat captain was, or at least thought he was, the king of the river; races to the canal were common, brawls were frequent, and the lockmen often bore the brunt of much ill-humor. In what was a vast understatement of the facts, Captain A. N. Lee officially reported in 1878 the work of the lock force was "often rendered very difficult by the conflicting interests and opinions of steamboat-men, some of whom have, during the past year as well as during previous years, ever been ready to find fault and condemn without reason, when the decision or order of the superintendent was not in accordance with their individual opinions and for their special benefit."²⁵

Several measures were taken to mechanize lock operation, and attention was given to other plans for expediting

movement of the burgeoning coal traffic through the canal. A telegraph line, later replaced by telephone, was installed in 1876 between the head of the canal and the locks to permit better management of traffic entering the canal. General Weitzel first suggested purchasing horses to replace the men turning the capstans, but finally installed steam engines to turn the capstans with compressed air. The engines reduced the time required to open the lock gate to three and a half minutes, whereas manual operation had required up to twenty minutes; they also reduced operating costs by reducing the number of personnel necessary for operation.²⁶

To further speed lockage through the canal, the old three-flight lock was converted in 1880 to a two-flight system, with each chamber 50 feet wide and 300 feet long. But by 1896 few vessels passing through the canal were small enough to use the old lock system, and a movable bear-trap dam was placed across the upper chamber to flush the canal of mud deposits and debris, thereby lowering dredging costs. In 1914, when Lock and Dam No. 41 was under construction at the Falls, as part of the Ohio River slackwater project, the lock completed by the Louisville and Portland Canal Company in 1830 was filled and its site was covered with earth to provide space for office, power plant, and workshop facilities. The lock completed in 1872, however, was partially preserved throughout all subsequent project modifications, and the fine masonry used in its construction could still be viewed at McAlpine Locks and Dam in 1975.²⁷

Canal Politics, 1880-1911

It could be argued that establishment of the Louisville Engineer District, separate from all other districts, resulted chiefly

from the demand of Superintendent Philip J. Schopp that all employees at the canal earn their pay. At least, it is a fact that his desire to have the only hard-working personnel on the job precipitated a political imbroglio which caused the resignation of one District Engineer, the stationing of a District Engineer at Louisville with responsibility solely for the Louisville District, and the disruption of canal management for thirty years. The story of politics at the Louisville canal amply illustrates a problem which afflicted Engineer operations, and those of many other federal agencies, throughout the late years of the nineteenth century. The problem was part of a broad national situation during the era, involving the conflict between the political patronage, or "spoils" system, and civil service reform, a problem which reached the White House in 1881 with the assassination of President James Garfield by a disappointed office-seeker.

After the death of Captain A. N. Lee in 1879, Superintendent Philip J. Schopp had immediate charge of the Louisville canal under the general direction of General Weitzel, who spent his time chiefly at a canal construction project in Michigan. Because of ill-health, General Weitzel took leave in 1882, and from July 31, to September 18, 1882, the Louisville office was temporarily in charge of Major Francis U. Farquhar, and then transferred to Colonel William E. Merrill, Corps of Engineers, who had been in charge of the Cincinnati Engineer office since 1870. Throughout this period, no Engineer officer was stationed at Louisville and Mr. Schopp had local charge of operations.²⁸

In the autumn of 1884, Schopp had a gang of laborers at work moving stone by wheelbarrow up a thirty-foot incline for placement in a crib-dam. Schopp could not be at the work site every moment, and,

after observing the amount of work completed in his absence, he concluded the laborers were loafing on the job. At his office, about a quarter-mile from the work-site, he picked up a field glass and found his suspicion was justified. Schopp lectured the men on their short-comings, told them they were "not earning their money," and threatened to discharge them. He did not fire them, but refused to rehire them during the next working season and thereby made several enemies who went to local politicians with their complaint and contacted an attorney.²⁹

The Democratic administration of President Grover Cleveland took office in March, 1885, and, in June, O. H. Stratton, a Louisville attorney, brought charges against Schopp and others of the canal management, contending that all canal personnel had been Democrats in 1874, when the United States took it over, but all were Republican in 1885. Schopp was specifically charged with the "use of money, cigars and liquors at a coffee house, adjacent to said old locks to influence and corrupt voters at the election in 1878 to vote the republican ticket."³⁰

The Chief of Engineers ordered an investigation, and Colonel Merrill held an inquiry at the Louisville office, with Congressman Albert S. Willis, Democrat of Louisville and also Chairman of the House Committee on Rivers and Harbors, present and O. H. Stratton acting as prosecutor. Accusations were made by the employees Schopp had refused to rehire, but Merrill discovered the election of 1878, referred to in the charges, was between two Democrats — Republicans were not involved — and one of the laborers who had been refused employment on "account of laziness" refused to corroborate the stories of the other laborers. Merrill exonerated Schopp and other canal

employees of all charges.³¹

O. H. Stratton, the attorney, who also had hopes of finding employment as timekeeper on the project, engaged in vitriolic attacks on Merrill in local newspapers. One of his letters, for example, stated that Colonel Merrill "cracked his royal official whip over the heads of his superiors, and gloried in the spectacle that he had temporarily interred the reform movement Thus our distinguished army cuttle fish folded his paternal arms around the Ohio river improvements, and stood on the supposed reform debris, proudly waved the banner . . . and shouted 'Big Injun, Me!'" Colonel Merrill insisted that no man should be appointed to a supervisory post at the Louisville canal who was not an experienced engineer. River news reporter Will S. Hays of the Louisville *Courier-Journal* commented:

It is said that a man can't be Superintendent of the canal here unless he is a scientific, practical engineer. That's what's the matter with Ohio river improvements. Uncle Sam wants less "engineering" and more good, hard, horse, common sense, and he'll save money and have better improvements. A teaspoonful of common sense is sometimes worth a barrel of science.³²

Political pressures in Washington increased, and in December, 1885, the Chief of Engineers ordered Colonel Merrill to forward a list of all canal employees showing their political affiliation. Merrill replied that of the personnel on duty at the canal, who had been on the job since the United States took over in 1874, three were Democrats and fourteen Republicans; of the twenty-five men employed after 1874, six were Democrats, eighteen Republican, and one independent. By early 1886 the word had gotten out that Schopp was to be dismissed, and Colonel Merrill and the Office of the Chief of Engineers were flooded with applications.

One interesting application came from a man who claimed he deserved the job because he was a Democrat and wanted the position because it "pays as well as drumming through Arkansas with two or three large trunks."³³

A Louisville newspaper reported on February 3, 1886, that Superintendent Schopp had been fired and replaced by General Thomas Hart Taylor, a former Confederate officer who served as Louisville Chief of Police for eleven years, at the insistence of Kentucky Governor Simon B. Buckner, a Democrat and also a former Confederate General. Colonel Merrill was not informed of the Taylor appointment until after the news appeared in the paper. Merrill angrily wrote the Chief of Engineers that, although he knew General Taylor personally and liked him, Taylor was not an engineer and was not competent for the position:

Inasmuch as the Department has ordered me to appoint as my chief assistant on this great work a gentleman whom I consider incompetent, and a due regard for my reputation as an Engineer, compels me to request that I be relieved from the charge of the Louisville and Portland Canal.³⁴

A few days later, Colonel Merrill received an application from Mr. J. P. Claybrook for the position of assistant to General Taylor. Merrill advised Claybrook that if he wanted a job he should do as others had done and "get it through politicians." Claybrook accepted the good advice and got the position he wanted. Colonel Merrill was relieved from command of the Louisville office as requested on March 15, 1886, by Major Amos Stickney, but Merrill retained charge of the Cincinnati Engineer office and employed Schopp in that district. Whereas General Weitzel had charge of two waterways projects, the Louisville canal and the St. Mary's Falls canal, and Colonel Merrill

concurrently directed the Louisville and Cincinnati offices, Major Stickney had charge only of the Louisville office and established his headquarters in downtown Louisville. He was still in charge at Louisville when Engineer Districts and Divisions were formally established in 1888, and technically was the first Louisville District Engineer.³⁵

Congressman Albert Willis of Louisville continued to exert his political influence in Washington to get Democrats appointed to the Louisville canal. He wrote the Secretary of War in 1886, complaining that Major Stickney was just as obstinate as his predecessor about personnel changes at the canal and reminding the Secretary that "just prior to my departure from Washington you will recollect that the removal of offensive partisans from the Louisville and Portland Canal was determined upon and that it would be done on *your* return to Washington." It is not clear that this pressure had any great effect, however, on canal management.³⁶

After the Republican administration of President Benjamin Harrison took office in 1889, Major Stickney decided to rid the canal of Superintendent Thomas H. Taylor, who, in the opinion of Stickney, had upset the entire canal work force by creating the impression that he would replace them with his friends. Stickney recommended dispensing with the positions of Canal Superintendent and Assistant Superintendent and substituting the positions of Master Lock Manager and Deputy Lock Manager. Holders of the two new positions would have only the duties of supervising canal operation, while all construction and other duties requiring engineering abilities would be performed by United States Assistant Engineers (a title used to refer to any civil engineer employed by the Corps). The Chief approved

this arrangement, Superintendent Taylor and his assistant resigned, William M. Ekin and J. A. Needy were appointed to the new positions; and U. S. Assistant Engineer Robert R. Jones took over construction and engineering functions at the canal and Assistant Engineer Granville W. Shaw was assigned responsibility for open-river improvements over the Falls.³⁷

But the new arrangement did not work quite as well as Major Stickney had expected. Robert R. Jones, because he hired most temporary labor employed on the project, soon was attacked for "hiring democrats and ex-confederate soldiers to perform the work on said canal to the exclusion of ex-federal soldiers and republicans who have done good service for their party." A flood of petitions descended on the Republican President, Benjamin Harrison, and the War Department, claiming that Jones was a South Carolina Democrat, and that he and canal employees had torn down the campaign posters of Harrison and stamped on them, or merely daubed them with mud. One letter to the President baldly claimed that "To the victors, belong the spoils," and asserted:

Mr. Cleveland appointed Gen'l Taylor, a rebel, as superintendent and no kick was made. Since Cleveland left office the same crowd has been running the canal. All the leaders of the Republican party in Louisville, New Albany and Jeffersonville want Mr. Jones removed.³⁸

The District Engineer investigated and reported that R. R. Jones was a New Jersey Republican, that only a few canal employees were Democrats, and suggested, doubtless with tongue-in-cheek, that these employees ought to be left on the job where they might be converted by the Republican majority. He complained to the Chief that politics was interfering with more important duties and represented efforts of local politicians to secure control

of appointments at the canal. But the Secretary of War ordered the dismissal of R. R. Jones and William Ekin, the Lock Manager, and the employment of Hart Vance and Josephus W. Pell, both "good" Republicans. Colonel Merrill employed Jones in the Cincinnati District, and Jones had immediate charge of the Ohio River slackwater survey of 1911-1914 and became Cincinnati District Engineer in 1917. He wrote many valuable accounts of the early history of the Ohio Valley and early waterways projects in the region.³⁹

At the appointment of Vance and Pell, the District Engineer at Louisville tendered his resignation because of their "highly prejudicial" character, but it was not accepted. In 1892, however, there was another election and another change in the national administration. Democrat Grover Cleveland again took office, and the District Engineer removed Hart Vance and J. W. Pell and did not refill their positions; instead, he arranged the appointment of Lieutenant Hiram M. Chittenden, Corps of Engineers, as his deputy and assigned the previous duties of Vance and Pell to the Lieutenant. The new administration was flooded with petitions from navigation interests in the Ohio Valley requesting that the Louisville canal be placed under civil service laws to prevent the appointment of incompetents for political reasons. This was done in 1896, but before it was accomplished a good Democrat, Eugene M. Terry, was appointed Master Lock Manager.⁴⁰

The Master Lock Manager had occupied a government-owned house at the canal prior to 1893, when Lieutenant Hiram M. Chittenden moved into it. Mr. Terry, the new Lock Manager demanded occupancy of the house as part of his compensation, and the Secretary of War ordered Lieutenant Chittenden, by then the

District Engineer, to vacate the premises for the use of Mr. Terry. Chittenden sought and received reassignment. He surveyed a canal in Ohio, then went west to direct projects on the Upper Missouri River and administer the development of Yellowstone National Park; he became an unusually prolific author and historian and became the Corps' earliest proponent of federal flood control projects and multipurpose water resource development.⁴¹

Politics continued as usual at the Louisville canal. In 1897 the Republican administration of President William McKinley succeeded the second Cleveland administration, and Mr. Terry, Democrat, went the way of all previous Lock Managers. The Republican administration agreed to the abolition of the positions of Master and Deputy Lock Manager, but arranged the reappointment of Josephus W. Pell, Republican leader of the Louisville post of the Grand Army of the Republic (Union Civil War veteran organization), to the canal as Assistant Traffic Manager (there was no Traffic Manager) in 1897. Civil service regulations had been extended to canal personnel in 1896, and under these laws Mr. Pell remained at his post until his retirement in 1920.⁴²

Political efforts to control patronage at the Louisville canal persisted throughout the first decade of the twentieth century, and the standard rule was that the Louisville District Engineer first cleared any change in canal staff with the Secretary of War. Operations at the canal during that period were directed chiefly by Assistant Engineers J. H. Casey and Granville W. Shaw. There were several efforts to obtain their removal but none were successful.⁴³

In 1911 Senator William Bradley of Kentucky, a former Governor of the state, sought to arrange an appointment at the canal of a new Master Lock Manager;

there had been none for over a decade. The District Engineer and the Chief of Engineers made a complete report on the long history of politics at the canal, explained that the position of Master Lock Manager had been a "source of constant trouble and contention from the time of its creation," and carried high pay for nominal services. Reestablishment of the position was, in their opinion, unnecessary and would "upset the present good organization and invite a return of former troubles."⁴⁴

President William H. Taft, a former Secretary of War with intimate knowledge of the problems created by the patronage system, read the lengthy report and returned it with a notation for the attention of the Secretary of War:

Don't worry about the master lock manager, I am not going to reestablish an office like that.⁴⁵

Summary

The tax on commerce charged by the canal company prior to 1874 was indeed onerous, but the canal corporation was free of the influences of local politics. The conversion of the Louisville canal to a federal project in 1874 subjected the management of the canal to patronage politics at its very worst — politics so rife that it seriously interfered with proper administration and operation of the project. Patronage problems were common on many Engineer projects during the last quarter of the nineteenth century. The extension of civil service regulations to the Louisville canal, as to other Engineer installations, was beneficial both to Engineer personnel and to the proper administration of waterways projects.

Politics ideally expresses the will of the sovereign of the United States — its citizens — and the modern Corps of En-

gineers takes considerable pride in its responsiveness to the needs of Americans, as expressed at open public hearings and through elected representatives. Major General Lytle Brown, Chief of Engineers, 1929-1933, who had been Louisville District Engineer when President Taft finally closed the book on patronage at the Louisville canal, summarized the Engineers' position on the subject of politics in 1935:

It may be said with equal truth that politics may further the adoption of a project, and may prevent it. Furthermore, as may be claimed without disturbing the equanimity of a citizen or his faith in his government, politics is involved in everything that affects the welfare of the people of the Republic. Otherwise there would be no democratic principle in government.⁴⁶

But the story of the struggle of the early

District Engineers with patronage politics should not obscure the major developments at the canal during that era. Though the passenger-freight business of the steamboat packets, for which the canal was originally designed, dwindled during the last quarter of the nineteenth century, use of the river as a medium for economical transportation of bulky, low-value industrial materials was increasing, and the barge-towing system placed new burdens on the Louisville canal. Through continued mechanization and modification of the canal project, the early Louisville District Engineers and their staffs accomplished substantial improvement in handling the new traffic, in spite of meager funding policies and rampant political interference.

CHAPTER IX: TRIBUTARY STREAM PROJECTS, 1835-1900

The pioneers took care to locate settlements on or near a navigable stream, and they considered any stream which would float a boat at high water navigable, though in dry seasons it might have scarcely enough water to float a toothpick. The virgin lands were fertile, the settlers productive, and surplus agricultural produce was transported on many Ohio Valley waterways before the end of the eighteenth century. One of the earliest aids to waterborne commerce was the enactment of state legislation to resolve the first water users conflict, between the pioneer navigators and the mill-owners who sought to develop water power. Many, if not most, of the streams of Kentucky and Indiana in the Louisville Engineer District were declared legally navigable to prevent their obstruction by mill dams.¹

After the advent of the steamboat, public support developed for improving navigation on several streams tributary to the Lower Ohio, and, with the aid of Army Engineers loaned by the United States to perform surveys, a few Ohio River tributaries were improved for navigation by state governments and state-chartered private corporations. Congress seldom authorized federal projects for the improvement of streams tributary to the Ohio prior to 1865, but the deterioration of navigation on state projects and unimproved waterways, plus increased public and political support for federal civil works, brought appropriations for tributary streams in the postwar years. And small indeed was the stream which was not improved, or at least surveyed, with federal funds in the last decades of the nineteenth century. So many projects were authorized and partially funded on diminutive streams by Congress during this era that the rivers

and harbors bills earned the apparently well-deserved sobriquet "pork barrel."

General Godfrey Weitzel, Louisville District Engineer, summarized the problem faced by Congress in 1878:

Our country is so large that if Congress were to appropriate annually all that is asked for by the officer in charge of the public improvements of the country, the amount of the bill would be so large that it would raise a storm of indignation all over the country.

If, to avoid this, an attempt should be made to classify the works according to their importance and thus complete them in their order in a prompt and economical manner, carrying the annual expenditures for this purpose at a sum which would not be objected to by the body of tax-payers, such an attempt would be a total failure in Congress. For it would be impossible to convince the people of one section that there was any public work in any other more important than that in their own.

So Congress must do the best under the circumstances, and try to give every section its just share. The result is that all of our large public improvements are carried on more slowly and at greater expense than public works in other countries, or large works in this country conducted by corporations or companies.²

In addition to the Falls of the Ohio project, General Weitzel was assigned responsibility in 1867 and 1870 for surveys and projects on the Tennessee, Wabash, and Cumberland rivers. The Cumberland-Tennessee rivers projects were transferred to the Chattanooga-Nashville Engineer District in 1871, but the Wabash remained the responsibility of the Louisville District. Work on other tributaries of the Lower Ohio were at first the responsibility of the Cincinnati Engineer district, but they also eventually became part of the mission of the Louisville District; and tributary projects constituted a major part of the District program in the late nineteenth century. The three largest

tributary streams in the Louisville Engineer District are the Wabash, Green, and Kentucky rivers, and projects for the improvement of navigation on those streams are an integral part of the history of the District.

*Early Navigation Projects on the Wabash,
1822-1860*

American Indians and French traders commonly traveled the Wabash as a connecting route between the Great Lakes and the Ohio and Mississippi valleys. Thomas Hutchins and George Washington, among others, recognized the strategic and commercial importance of the Wabash and the heavily-traveled portages between it and the streams which flow into the Great Lakes. During the Revolution George Rogers Clark won control of the Wabash Valley for the United States from a British army from Detroit which crossed the portage and descended the Wabash to Vincennes.³

From the earliest days of settlement in the Wabash Valley, the pioneers sent their produce to market via the Wabash and its tributaries. In the spring of 1826, 152 flatboats passed Vincennes bound for New Orleans, transporting such commodities as 250,000 bushels of corn, 2500 head of cattle, 3600 venison hams, and other farm produce. During the 1830s and 1840s, over a thousand flatboats annually navigated the Wabash on the way to market and flatboat construction became a specialized industry in the valley. Keelboats, in great numbers, carried in most of the upstream trade until after 1823 when the steamboat *Florence* first reached Terre Haute. In 1825 the first steamboat reached Lafayette; and in 1834 the *Republican* arrived at Logansport, though it had to be towed by oxen to make the voyage. At high water, steamboats navigated such

Wabash tributaries as the Vermilion River (up to Danville, Illinois), the east fork of the White River (to Petersburg, Indiana), and in 1831 the *General Hanna* steamed up the White River to Indianapolis.⁴

Waterborne commerce on the Wabash thrived, in the absence of other convenient transportation facilities, and citizens became interested in projects to improve navigation at an early date. In 1822, Indiana and Illinois appointed William Polke and Thomas S. Hinde to survey the Wabash and plan its improvement. They recommended clearing a channel through shoals "at least 21 feet wide and three feet deep for the passage of New Orleans keel boats; and 30 feet wide to admit Steamboats through" and construction of a canal around Grand Rapids, or the "Falls of the Wabash," a few miles below Vincennes. But their recommendations were not implemented.⁵

Congress authorized a survey of the Wabash in 1828, which was completed by Captain John L. Smith, Corps of Engineers, and his assistant John K. Graham in 1829. They examined the Wabash from its mouth to Logansport, Indiana, and Captain Smith recommended the authorization of a slack-water project with a minimum navigable depth of 2½ feet below Vincennes and 1½ feet above. The project involved the construction of low timber-crib, stone-filled dams below shoals, with movable "sluice" gates, instead of locks, in each dam for the passage of traffic. Initial costs were estimated at \$65,094.29.⁶

The Indiana legislature resolved in 1833 that the Wabash and White rivers were "reserved national streams," serving as outlets to market for a large population, and as such deserved the aid of the United States. Congress enacted a bill in 1834 which would have provided \$20,000 to

commence construction of the slackwater project recommended by Captain Smith, but President Andrew Jackson vetoed it on the grounds that it was "extravagant" and the Wabash River lacked a port of entry.⁷ This veto had far-reaching consequences for navigation on the Wabash. The financial resources of Indiana were tied up in disastrous canal projects and the state never adopted effective measures for improving navigation on the Wabash. Because of the dangers and delays attending navigation of the unimproved river, commerce switched to roads and railroads as soon as they were available. By the time federal projects on the Wabash commenced it was too late to revive waterways traffic on the Wabash to any appreciable extent.

The only pre-Civil War improvement of navigation on the Wabash of value was completed by a private company, the Wabash Navigation Company, chartered by Indiana in 1844. The company was authorized to improve the river and charge tolls for its use; no general improvements were undertaken however, but the company did complete a lock and dam at the worst obstruction, the Grand Rapids shoals. David Burr and Sylvanus Lothrop, civil engineers, designed and supervised construction of the lock and dam, which consisted of a 210- by 52-foot lock and a 1,030-foot long, 57-foot wide, 10-foot high dam. The gradient of the Falls at Grand Rapids was about ten feet in a distance of 700 feet, and the lock had a lift of about twelve feet. The timber-crib structure was completed in 1849, at initial costs of \$70,000, and in its first five months of operation locked through 245 steamboats.⁸

*Federal Projects on the Wabash,
1870-1900*

Congress ordered a survey of the

Wabash in 1870, and General Godfrey Weitzel appointed Frederick Stein, assistant engineer, as chief of survey. Stein examined the Wabash from its conjunction with the Salamonie River to its mouth. He noted that, because of obstructions in the river and the disintegration of the lock and dam at Grand Rapids, commerce on the river was diminishing, and recommended reconstruction of the Grand Rapids project, snag-clearance and dredging, and various other improvements on the Wabash up to Lafayette, Indiana, to restore a navigable channel, stimulate the return of pre-Civil War traffic, and permit development of mineral resources. General Weitzel concurred with these general recommendations; and Congress made its first appropriation for the Wabash River in 1872.⁹

Mr. Stein, as superintendent of the project, made some progress in removing accumulated debris and snags and closing secondary channels with dams in the 1870s; however, the work was often interrupted by mishap. In 1872, for example, a smallpox epidemic broke out aboard the Engineer fleet and "the crews ran off"; in 1879 malaria caused the death of several workers and forced suspension of operations; and, because of the alluvial character of the banks of the Lower Wabash, a number of the timber-crib structures built to close channels were breached and washed out.¹⁰

The improvement of the Wabash was assigned to a special Engineer District established at Indianapolis, under the command of Major Jared A. Smith of the Corps, in 1877. The reason for the establishment of the special District is not clear; however, it is suspected that there was political pressure from Indianapolis interests who wanted a navigation project on the White River to compete with rail-

roads. Major Smith inspected the Wabash and found a substantial commerce in agricultural produce below Grand Rapids but only two steamboats operating above that point. The value of further improvements on the Upper Wabash were, in his opinion, a "matter of conjecture." On the other hand, he also examined navigation on the White River, from Indianapolis to the Wabash, and found it to be "the natural outlet to a wonderfully productive portion of the State."¹¹

Congress funded a project to remove snags, blast a navigable channel, and construct spur-dikes on the White River in 1879, and Major Smith directed active work for a few years. The project did stimulate a little traffic; by 1887 three steamboats were plying the White River, transporting chiefly grain and lumber. Major Smith reported that despite the small amount of commerce on the White, the project had more than paid for itself because railroads had reduced rates to the region to meet potential waterways competition.¹² The use of waterways as regulators of railroad rates was a feature common to many late nineteenth-century project rationales, and reductions in regional railroad rates were listed as "Effects of Improvement" in the *Annual Report of the Chief of Engineers* until 1932.

The Indianapolis Engineer District closed in 1885, and the Wabash-White River projects were transferred back to the Louisville District, which terminated the Wabash project above Grand Rapids until the lock and dam, funded in 1885, was completed at Grand Rapids to open the Upper Wabash to through navigation. The Grand Rapids lock and dam project was a monumental case of "too little, too late." When the project, with a stone-masonry lock, lock-gates of white oak, and a timber-crib dam, opened to naviga-

tion in 1894, Wabash River commerce was dead. In its first year of operation, Grand Rapids Lock served two steamboats plus assorted houseboats and skiffs. The Assistant Engineer in charge of the project said:

The cause of this lack of river traffic is not difficult to find. The Wabash improvements were begun by a joint commission of the States of Illinois and Indiana at an early day, before rail-ways were known, or their great carrying power understood, and when river traffic was the sole mode of transportation. But since then a vast network of railways have crossed the entire Wabash Valley between Terre Haute and the mouth of Wabash River. Eight great through lines of railway cross this stream between Terre Haute and its mouth.¹³

At the turn of the century, the Louisville District Engineer reported that if the improvement of the Wabash for navigation were to be continued, "a comprehensive and correct survey of the river is prerequisite to the preparation of an intelligent project and estimate for the systematic improvement of the river." In 1903 the District recommended a six-foot slackwater project for the Lower Wabash up to Vincennes, consisting of eleven locks and dams at costs of three and a half million dollars. Studies of the economic structure and transportation needs of the Wabash Valley then indicated that a thriving waterborne commerce, particularly coal-barging, would utilize the project if constructed. But the Board of Engineers for Rivers and Harbors, in line with reordered priority calling for completion of projects already underway, rejected the proposed slackwater project for the Wabash, stating that no new projects would be undertaken on Ohio River tributaries until the slackwater project on the Ohio was completed. No slackwater project on the Wabash was ever completed, though one was still under con-



The Grand Rapids locks and dam on the Wabash River

sideration in 1975.¹⁴

Early Navigation Projects on Green River, 1828-1842

The first American pioneers to settle in the Green River Valley used the river and its tributaries to send produce in flatboats to New Orleans, but Evansville, Indiana, on the Ohio just below the mouth of the Green, eventually became the marketing center for Green River commerce. During much of the nineteenth and for several decades in the twentieth century, the Green River Valley supplied Evansville saw mills and wood-working plants with timber; Evansville claimed in 1898 to be the largest hardwood manufacturing center in the world. Logs cut on the Green River or its tributaries in July, were allowed to dry until winter, then pinned together with wooden pegs in rafts and floated down to Evansville.¹⁵

The steamboat *McLean* was the first to reach Bowling Green in 1828, and it was followed by other boats at each high water. In 1828 also, Kentucky established a Board of Internal Improvements, which requested the loan of United States Army Engineers for surveys of streams in Kentucky. Lieutenant William Turnbull and Lieutenant Campbell Graham, Topographical Engineers, surveyed the Green River in 1828 and turned the results over to the state Board. As part of its state-wide internal improvements program, Kentucky authorized development of a slackwater project to improve navigation up the Green and Barren rivers to Bowling Green in 1833, and employed an experienced civil engineer, General Abner Lacock, former Congressman and Senator of Pennsylvania and engineer on the Pennsylvania canal system, to locate the locks and dams. The Green-Barren River project was the first improvement of its

kind in the United States, and canal engineers were the men with the most closely related experience. (As previously mentioned, construction of a slackwater project became known as a "canalization" project; that is, to make like a canal.)¹⁶

William B. Foster, also a Pennsylvania canal engineer, was first resident engineer in charge of construction, but because of ill-health he resigned in early 1835 and the project was completed under the direction of Alonzo Livermore, another Pennsylvania canal engineer recommended by General Lacock. Construction of Locks and Dams Nos. 1 and 2 was underway when Livermore took over; however, Livermore modified their designs to increase lock chamber dimensions to 160 feet long by 36 feet wide. He selected the sites of two more locks and dams on the Green (Nos. 3 and 4) and one on the Barren (No. 1) to establish 175 miles of six-foot slackwater navigation from the mouth of the Green up to Bowling Green on the Barren. The locks were constructed, under contract, of sandstone masonry laid in Louisville hydraulic cement (except No. 2 which was laid in common lime). To overcome a gradient of 78 feet in 175 miles, the locks averaged fifteen and a half feet of lift. The dams were timber-crib, rock-filled structures, with masonry abutments.¹⁷

Several contractors failed on the project, and other problems were experienced — chiefly resulting from poor foundation conditions and damages to completed work by floods. A flood in 1840, for example, breached an abutment of Lock and Dam No. 3 and carried away the lower lock-gates. Exclusive of the costs of snag-removal and general channel clearance, initial construction costs aggregated \$780,000 — about \$10,000 per

foot of lock-lift. This cost was about triple the original cost estimates; however, the first estimates were for smaller locks and lesser-quality materials and did not provide for such contingencies as the costs of repairing flood damages.¹⁸

Though the project was not entirely completed in 1841, the steamboat *Sandusky* locked through to Bowling Green late in the year, thereby clearly demonstrating, one contemporary observer said, that "the removal of the obstructions to the navigation of all the great rivers of the West is practicable." Over \$2,000 in tolls were collected during the first year of operation and fears that the project would form a health hazard and would be a waste of money were dissipated. Residents of the Green Valley readily acknowledged the "advantages derived from a perpetual line of the finest water navigation in the world." Regular steamboat trade between Evansville and Bowling Green was inaugurated; citizens of Bowling Green constructed a six-story warehouse at the river and a mule-powered railroad to connect the landing with the business section; and the project provided a substantial economic boost to the commercial development of the region.¹⁹

Free Navigation on the Barren and Green, 1865-1890

The navigation structures on the Green and Barren rivers were damaged and their maintenance was neglected during the Civil War, and in 1868, rather than expend the funds necessary to repair the project, the state legislature leased the works to the Green and Barren River Navigation Company, an organization of bankers, attorneys, and steamboatmen led by W. S. Vanmeter, the steamboat

captain who had obstructed Lock No. 3 for the Confederacy in 1862. The company operated the project, opened mines and entered other business, and ran its own steamboats, the *Evansville* and the *Bowling Green*. Since company-owned vessels paid no tolls, the company soon drove competition from the river and established a *de facto* monopoly.²⁰

Opposition to the monopoly soon developed, and it had very influential leadership in the person of General Don Carlos Buell, former Union General who settled in the Green Valley (at Airdrie, Muhlenburg County) after the war, opened coal mines, and began shipping coal down river to Memphis in late 1865. His business grew until 1868, when the navigation company took over the project and, with its toll-free privileges, undersold him and drove him from the market. General Buell led a campaign to end the company monopoly and free the river of tolls. When his efforts failed in the state legislature, he took the case to Congress, contending:

If the claim of Green River to the care of the Government as a public avenue rested on nothing but the expressive fact that at one period in our civil war the slackwater navigation served as a valuable channel of supplies for a Union army at a critical moment when all other lines failed, the question might properly be dismissed. But the ordinary trade of the Green River country has been relatively large from the earliest settlement, and the magnitude of its undeveloped resources especially in minerals, demands for it the facilities of an extended interstate commerce.²¹

General Buell's complaint that the company rested "like an incubus on the destinies of the Green River Valley" brought Congressional action in 1879. An investigation was ordered, and the Corps of Engineers reported that tolls on the Green and Barren rivers were excessive and that a monopoly did exist. Congress

directed the Corps to ascertain the steps necessary for federal purchase and toll-free operation of the project, and a special Board of Engineers convened at Bowling Green in 1886. The Board conferred with directors of the company, inspected the project, reported that an injurious monopoly did exist, and recommended "in justice to the country tributary to the Green and Barren rivers, the present obstructive tax on its commerce should be removed." The Kentucky legislature ceded its rights to the project to the United States in 1886, and Congress purchased the company franchise for \$135,000 in 1888.²²

Lock No. 3, the one most heavily damaged during the war, collapsed in 1887; other locks were in poor condition; the channel was littered with snags; and through navigation on the river had been suspended when the United States took over the project. Lieutenant William L. "Goliath" Sibert, Corps of Engineers, was assigned the duty of reopening the river to navigation. Sibert, a physically large man, had roomed at the Point with diminutive David Gaillard — hence Sibert's nickname "Goliath." His work on the Green and Barren river project was his first civil works experience and it launched him on a distinguished engineering career which took him around the world, but he was to call the Green River Country home ever afterwards. Sibert established an Engineer office at Bowling Green, arranged construction of the snag-boat *William Preston Dix* to clear the Green River of snags, and initiated an emergency reconstruction of Lock No. 3 to reopen the river.²³

Difficulties were experienced in pumping water out of the cofferdam at Lock No. 3 in 1889, and in 1890 Lieutenant Sibert called in a waterways en-

gineering expert, Benjamin F. Thomas, U. S. Assistant Engineer on the Big Sandy River, who got the cofferdam pumped out in ten days, put in the new masonry, and opened the lock to navigation on November 10, 1890. Residents of the Green Valley were "jubilant" and hundreds gathered at the river to see the first boat pass through toll-free. General Buell reopened his coal mines, the timber-rafting business increased, and, because the boats could transport commodities at about half the prevailing rail rates, railroads reduced rates to meet the competition. Commerce on the river quadrupled — as many as sixteen steamboats soon plied the waterway regularly. The editor of the Calhoun, Kentucky, *Constitution* wrote in 1890:

It is very observable that since Green river has been made free to all who desire to run any kind of craft upon its waters, commercial affairs are assuming larger proportions; new farms are being opened, and various kinds of manufacturing establishments are springing up along its course.²⁴

Rough River Project

The success attending the repair and toll-free operation of the Green River project stimulated support for extending the slackwater system. Of special interest was the project constructed on the Rough River to furnish slackwater from the confluence of the Rough with the Green up to the town of Hartford, Kentucky — it was the first river lock constructed entirely of monolithic concrete in the United States.

A Kentucky state engineer had surveyed the Rough River in 1836 and recommended a slackwater system for the stream to permit development of timber and mineral resources, but it was not done. In 1856 the Rough Creek Navigation and Manufacturing Company was

incorporated; shortly after the Civil War it constructed a crude lock and dam about eight miles from the mouth of the Rough and a regular steamboat traffic developed up to Hartford. The trade ended, however, when the Green River company imposed tolls and the Rough Creek company abandoned its lock and dam.²⁵

Congress authorized a project to reestablish traffic on the Rough River in 1890. Trees were cleared from the banks, snags removed from the channel, and construction of a new lock and dam, near the site of the old one, commenced, under the direction of Assistant Engineer William M. Hall. Hall later directed the construction of sixteen locks and dams on the Upper Ohio River, and implemented a number of novel waterways engineering methods, such as those for anchoring concrete structures to foundation rock and for drilling cores from substrata to ascertain foundation conditions. Plans for the Rough River lock called for the use of common stone masonry in construction, but bids for furnishing cut-stone were excessive because of limited access to the project site, and Hall recommended the substitution of concrete of "imported Portland cement." The Chief of Engineers approved in 1895, and construction of the concrete lock, with chamber dimensions of 27 feet width, 123 feet length, and 9 feet lift, was completed in 1896, at a cost of \$85,000.²⁶

In 1899, three steamboats and a number of small vessels were plying the Rough River up to Hartford; they transported 10,883 tons of freight in that year. But 1899 was just about the peak for traffic on the Rough River. The project, except for its precedent-setting construction method, was a signal failure. No extensive traffic ever developed on the Rough River, though it is possible, because of

low construction and operation costs, that during its many years of operation the public investment in the project was adequately reimbursed in the form of lower transportation costs, if reductions in rail rates are included.²⁷

Green River Slackwater Extension

When R. H. Fitzhugh, assistant to Colonel William E. Merrill, examined the Green River in 1879, he reported it would be feasible to construct eight locks and dams above Lock and Dam No. 4 (at Woodbury, Kentucky) on the Green River to extend slackwater navigation to such communities as Brownsville, Munfordville, and Greensburg. Fitzhugh explored Mammoth Cave, reported that the water in the cave was at the same level as the river, and concluded that a slackwater project would have no more effect on the famous cave than an ordinary rise in the river.²⁸

No action was taken on the Fitzhugh report, but, concurrent with successful reopening of the old state project on the lower river, another examination of the Upper Green was authorized in 1890. Lieutenant William L. Sibert reported the construction of two additional locks and dams (Nos. 5 and 6) on the Green could open mineral and timber resources of such tributaries as Bear Creek and Nolin River to development and establish waterways transportation to the popular resort area at Mammoth Cave. Congress approved construction of Locks and Dams Nos. 5 and 6; William M. Hall moved Engineer equipment from Rough River and commenced construction; and in 1906 the steamboat *Chaperon* made the first run from Evansville to Mammoth Cave. A regular tourist and excursion traffic developed to and from the Cave region and commerce on the Green River



Rough River Lock—View on 16 December 1896, showing upper entrance to the lock with packet boat *City of Hartford* being locked through.

system increased, but the public investment in Locks and Dams Nos. 5 and 6 was probably never reimbursed. Timber and asphalt resources on the Upper Green were developed to a limited extent, but general commerce was also served by the Louisville and Nashville Railroad and the turnpike between Bowling Green and Louisville.²⁹

Early Navigation Projects on the Kentucky River

Some of the first settlements in Kentucky, notably Boonesborough founded by Daniel Boone in 1775, were located along the steeply palisaded gorge of the Kentucky River. Use of the Kentucky river for commerce was concurrent with the earliest use of the Ohio for that purpose. General James Wilkinson initiated trade with New Orleans in 1787 with flatboats freighted with Kentucky River Valley produce. In addition to agricultural produce normally exported via Ohio Valley waterways, large quantities of hemp, tobacco, and salt went to market at an early date via the Kentucky River. The first steamboat to navigate the Kentucky River was constructed by Edward West at the mouth of Hickman Creek in 1816, and in 1818 James Johnson and Richard M. Johnson (Vice President of the United States, 1837-1841) built several steamboats on the Kentucky near Frankfort, which joined the *Western Engineer* in the expedition to the Missouri Valley in 1819.

Interest in improving navigation on the Kentucky developed not long after the Commonwealth achieved statehood. In 1801 the Kentucky River Company, authorized to clear the river and charge tolls, was chartered, but it evidently accomplished very little. In 1828 and 1829, Lieutenant William Turnbull and

Lieutenant Napoleon B. Buford, Topographical Engineers, surveyed the Kentucky from its mouth at Carrollton to Boonesborough. They recommended to Congress that an experimental wing dam be constructed on the Kentucky River, and, if the experiment were successful, a navigation project be adopted. President Jackson vetoed a bill which would have funded federal work on the Kentucky, however, and the Commonwealth improved the river with its own funds.³¹

The Kentucky was resurveyed in 1835 by state engineer R. Philip Baker, former assistant to Colonel Stephen H. Long, and Lieutenant Buford, the former Topographical Engineer. They recommended a system of seventeen locks and dams on the mainstream to establish a six-foot slackwater depth to the Three Forks at Beattyville, Kentucky. They also suggested slackwater navigation up South Fork of the Kentucky to open navigation to the salt works at Goose Creek and pointed out that a canal could be constructed from the South Fork to the Cumberland River at Pineville, Kentucky. It was even feasible, in their opinion, to build a canal through Cumberland Gap to the Tennessee River watershed and through mountain gaps to the rivers of Georgia leading to the Atlantic; thus, providing the Ohio, Kentucky, Cumberland, and Tennessee valleys with an outlet to the Atlantic, a "Southern Route" competing with the Erie Canal.³²

The visionary canal route was never seriously considered, but there was support for a project on the mainstream of the Kentucky. The *Frankfort Commonwealth* commented that the opening of the river to navigation would "penetrate into the very heart of the State — develop the resources of an extensive region of the country, which without such an improvement,

must be forever valueless — open up a way to the inexhaustible coal mines near the sources of the Kentucky, and also to the salt works.” The Commonwealth authorized construction of a slackwater project on the Kentucky in 1835, and Sylvester Welch, the Pennsylvania engineer who had designed the famous Allgheny Portage Railroad, was selected as project engineer.³³

Sylvester Welch directed construction of five locks and dams to establish 95 miles of six-foot slackwater from Carrollton to Oregon, Kentucky, a few miles above Frankfort. But construction of Locks Nos. 6 and 7 was suspended in 1842 after funds had been exhausted. At construction costs of about \$900,000, five timber-crib dams and masonry locks were completed, the locks with chamber dimensions of 38 feet width, 145 feet length, and an average of 14 feet lock-lift. The Kentucky River project was never a profitable investment for the state — toll collections, after payment of operating costs, paid less than one percent annually on initial costs. But project purposes were amply fulfilled, for available economic navigation stimulated development of the Kentucky Valley and Bluegrass region, whose products and produce moved steadily down the waterway to market at Louisville and down river ports.³⁴

As on the Green River project, maintenance of the Kentucky River project was neglected during the Civil War and waterborne commerce dwindled. The state legislature was unwilling to appropriate the funds necessary to repair the navigation structures, and in 1865 turned the project over to the Kentucky River Navigation Company, a public corporation financed by the bonds of counties bordering the river. But a court declared the bonds illegal, the company lease on the

project was annulled, and operation of the project ceased in 1873. Napoleon B. Buford, the officer who had conducted the original surveys in 1828 and who had become a Major General of Union volunteers in the Civil War, introduced a bill in the Kentucky legislature in 1878 to raise a million dollars for the revitalization of the project, but it failed and the Kentucky delegation to Congress requested federal aid.³⁵

Congress authorized a federal study of the project in 1878, and Colonel William E. Merrill selected R. H. Fitzhugh for the task. Fitzhugh recommended repair of the old state project and extension of slackwater to Beattyville and a considerable distance up the Three Forks. Colonel Merrill limited the recommended project, however, to reconstruction of the five old structures and the building of twelve more to canalize the river to Beattyville. Congress authorized and funded the project in 1879, and Kentucky ceded jurisdiction over the old project to the United States on March 22, 1880.³⁶

A separate Engineer District for the Kentucky River and a few other streams tributary to the Ohio was established at Cincinnati. It became known as the Second Cincinnati District to distinguish from the First Cincinnati District which was responsible for general improvement of navigation on the Ohio. The Second Cincinnati District demolished the rotted timber-cribs of the old state project, reconstructed the dams, repaired the locks, removed snags from the channel, and reopened navigation on the Kentucky up to Frankfort in March, 1881. Traffic revived on the river, furnishing transportation for about ten cents per hundred-weight, as compared with twenty-three cents by rail. In the first year of operation, coal shippers alone were saved \$66,000 in

freight charges. In the opinion of the Second Cincinnati District, reopening navigation on the Kentucky River had immediate and sweeping results; it reported: "The people tributary to the river seem to have been stimulated to new life by these conditions, as is evident by the generally-improved conditions of the farms and farm-houses and the increased acreage under cultivation."³⁷

The Beattyville Project

In 1882 Congress, as a result of political pressures from representatives of the Upper Kentucky Valley, provided that \$75,000 of the Kentucky River appropriation be applied to the construction of a lock and movable dam at Beattyville. The appropriation was made without survey, without previous study, and without the approval of any office of the Corps of Engineers. Corps plans called for extending the slackwater project on the Kentucky upstream from old Lock and Dam No. 5 as appropriations permitted. But citizens of the upper valley wanted a slackwater pool up the Three Forks from Beattyville to provide a safe harbor for commodities awaiting a navigable water stage on the mainstream of the Kentucky to descend to market. Great losses occurred annually on the Three Forks when log-rafts and flat-boats loaded with coal, iron, and salt were destroyed by sudden violent floods and ice jams.³⁸

A special Board of Engineers recommended in 1883 that construction of a lock at Beattyville be held in abeyance until an ascending traffic developed to require it and, and, instead, a movable bear-trap gate be installed in the crest of the dam. The Second Cincinnati District completed the project in 1886; it was a timber-crib, stone-filled dam with two wooden, two-leaf, bear-trap gates (or

"weirs"), each sixty feet wide. These were the first bear-trap gates constructed by the Corps of Engineers.³⁹

When the mainstream of the Kentucky reached a navigable stage, the bear-trap gates in the crest of the Beattyville dam were to be collapsed, water would flow from the upper pool through the openings, boats and rafts would slide over the bear-traps and down inclined chutes between guide walls, and then continue their voyage to market. But the plan did not work well. The velocity of the current down the chute on the lower side of the dam was too great; a number of boats wrecked when descending; and boat crews and raftsmen often became frightened and jumped for their lives as their craft entered the chute, leaving them to run wild down the river. The pressures generated by water velocity also wore and tore away sections of the chute and guide walls. In 1887 the bear-trap scheme was abandoned and construction of a lock commenced, but in 1891 all further work was suspended. A railroad line crossed the Kentucky Valley above Beattyville, and, except for log-rafts, transported all freight which formerly moved down the river.⁴⁰

Extension of Slackwater Project

An independent study of Kentucky economic and industrial development completed in 1887 pointed to the restoration of waterborne commerce on the lower Kentucky river as an excellent example of the broad economic stimulus cheap waterways transportation could provide and recommended rapid completion of the Kentucky River slackwater project to Beattyville, chiefly to facilitate development of coal and mineral resources. The study recommended:

On the score of economy, it would be better for Congress, instead of making appropriations by



Kentucky River Lock and Dam No. 1—view south shows breach and cribs, 1883

dribblets, to set apart a sum sufficient to place all the remaining locks and dams under contract at once, and complete them in two or three years, instead of making a lock and dam every year or two, extending the time for the completion of the navigation ten or fifteen years, and suffering losses from floods, &c., from the incompleted state arising from lack of adequate appropriations.⁴¹

But Congress did not accept this latter suggestion, or many other similar recommendations, and the Kentucky River slackwater project was not completed until 1917, after some thirty years of sporadic construction. The original project of 1883 called for the construction of twelve locks and dams in addition to the five old state structures; it was modified by increases in lock-lift to fifteen and eighteen feet to reduce the number of new locks and dams to nine, and the project, as completed in 1917, had fourteen navigation structures. Twenty-four steamboats, fourteen of them passenger packets, were plying the Kentucky, but the transportation of coal was handled almost completely by railroads in 1900. The steamboat trade on the Kentucky began to dwindle after 1900 and by 1917, the year Lock and Dam No. 14 was completed, it had reached a very low ebb, as had waterborne commerce on most other inland rivers, including the Ohio.⁴²

Other Tributary Projects, 1865-1900

As previously noted, the stream which was not surveyed at the direction of Congress for a navigation project in the late nineteenth century was small indeed. Colonel William E. Merrill was once ordered to survey a stream which he could remember walking across at its mouth during the Battle of Perryville in 1862 without wetting his feet. The Louisville Engineer District was directed to survey scores of rivers for possible navigation projects during the era, and many were on

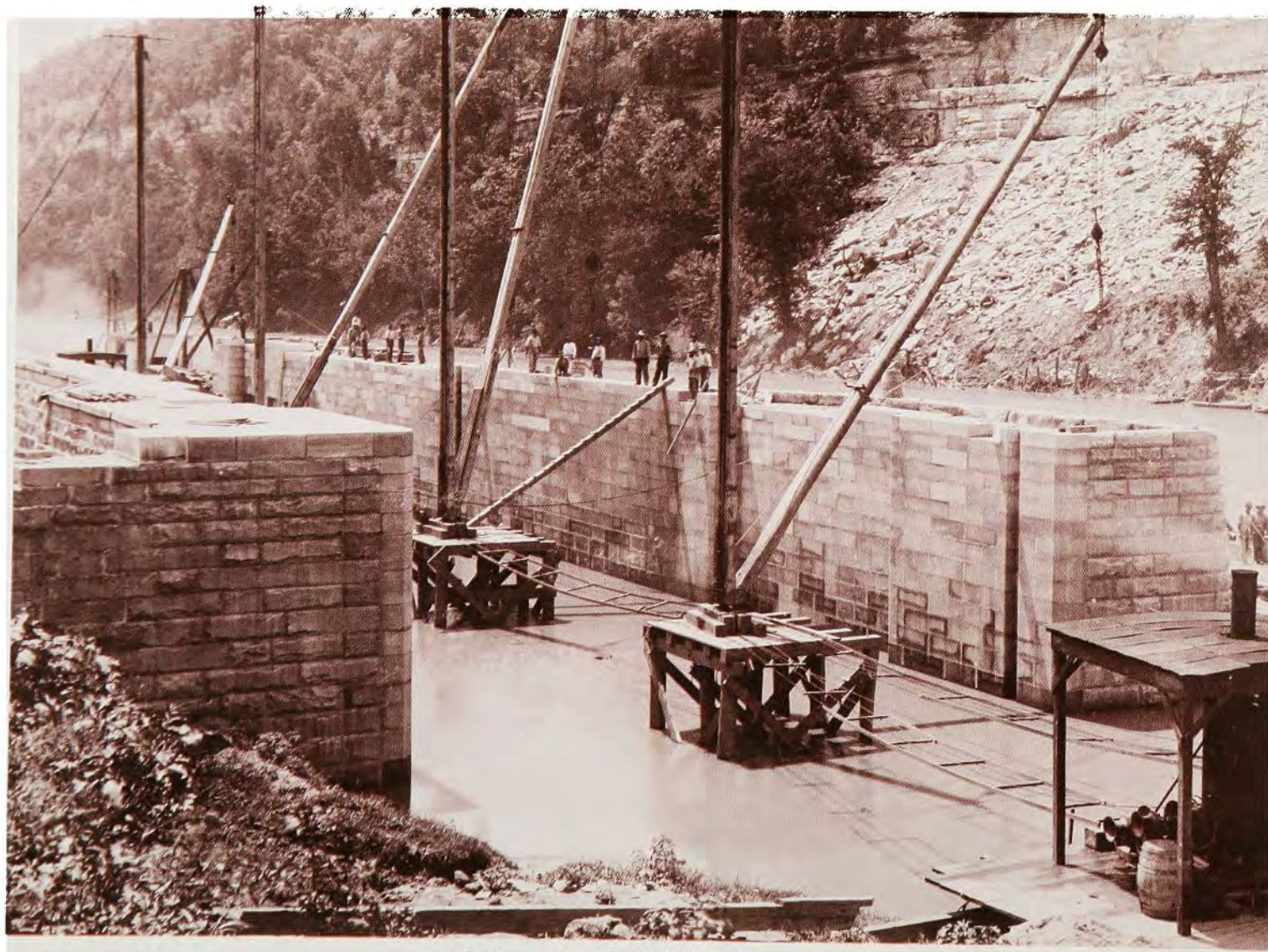
streams which were patently unfit for any kind of commercial navigation. Congress once ordered a survey of a stream which the Chief of Engineers was forced to admit the Corps could not accomplish, because, after diligent search, no such river could be found.⁴³

The remarks of General Weitzel about the political problems attending rivers and harbors legislation will be recalled. They were applicable, in general, to every rivers and harbors bill until the twentieth century; in efforts to satisfy constituents, Congress authorized and funded many surveys and projects of questionable value in order to get sufficient support for important and beneficial projects. At times, however, the Corps was able to accomplish more on "pork barrel" projects than might have been expected. The Tradewater River in the Louisville Engineer District provided an excellent example.

The Tradewater River is a narrow, tortuous stream with a drainage basin about sixty miles long and twenty miles wide, which joins the Ohio River just below Caseyville in Western Kentucky. The Rivers and Harbors bill of 1878 included a provision for a survey of the Tradewater, and Congressman Samuel S. Cox of New York, in opposing the bill before the House, said: "There is a provision here for the survey of a river in Kentucky which a friend of mine near me says ought to be macademized. [Laughter] That is the only way to make it a thorough-fare. [Laughter]"⁴⁴

Congressman John Kenna of West Virginia replied:

When a gentleman comes before the committee and asks for a survey of a river which he states is navigable and of commercial importance, how in the name of God can any committee be protected from imposition, if the facts are not represented except by an official and proper survey?⁴⁵



Kentucky River Lock No. 7—looking upstream, 1897

Rather than provide funds to "macadamize" the Tradewater, Congress authorized the survey. The Corps found that large quantities of agricultural commodities, which might use the river, went to market from the Tradewater Valley via miserable roads, and coal shipments on the river, which totaled 7,692 tons in 1880, could be expected to increase if navigation were improved. Congress appropriated \$3,000 for improvement of the Tradewater in 1881 and subsequently made a few other small appropriations. Engineer work parties cleared the Tradewater, removing snags and overhanging trees and blasting rocks from shoals to create a forty-foot wide and three-foot deep channel on the lower forty-one miles of the river. By 1886 five small steamboats were plying the Tradewater, transporting small amounts of general freight and large amounts of high-quality coal. Coal shipment on the Tradewater rose to 30,000 tons in 1889, triple the amount shipped when the project was authorized, and, in short, the limited Tradewater project provided substantial benefits.⁴⁶

But when Congress directed the Tradewater be surveyed for a lock and dam slackwater system in 1896, the Corps reported unfavorably, pointing out that at low-water it would require two or more hours to supply a single lockage and that railroads had entered the Tradewater Valley in the late 1880s and were providing adequate transportation facilities for the area. The Louisville District Engineer concluded the report with a few general observations:

The Tradewater River is in the same class with many others tributary to the Ohio River, in that an improvement of any character will be followed by an increase in the river trade. Many such rivers have been improved or are now under improve-

ment, and the results of these improvements, even on streams which are larger than the Tradewater and had originally a similar or greater promise of success, have not been uniformly encouraging. In general, the benefit has not been sufficient to warrant undertaking new work unless there is a practical certainty of a growth of commerce commensurate with the cost.⁴⁷

Summary

The efforts of the Army Engineers to improve navigation on streams tributary to the Ohio River seldom provided benefits sufficient to reimburse the public investment. Such successes as were experienced on the Green, Kentucky, and Tradewater Rivers were the exception, rather than the rule. Waterborne commerce on tributary streams diminished, in general, in the last quarter of the nineteenth century, and efforts to revitalize the traffic, like those made at the Grand Rapids project on the Wabash and the concrete lock on Rough River, were usually futile. As a result, by the end of the century, the Corps of Engineers was reluctant to approve any waterways project which could not be quickly completed to serve an already extant commerce.

Projects on tributaries would doubtless have been more successful had systematic funding and rapid construction been possible, but this was precluded by congressional policies, by the authorization of too many surveys and too many projects for the funds available to improve. In 1882, for example, Congress made appropriations for eighteen projects on which the Corps had reported *unfavorably*, and for sixteen (including Beattyville project on the Kentucky River) which had not been examined by the Corps at all.⁴⁸

It was somewhat surprising that the Engineers were able to accomplish as much as they did on tributary streams in the face of such meager and haphazard funding

policies. One authority has observed that if the deficiencies of waterways funding policies had been as negligible as those of the Corps of Engineers, rivers and harbors bills would never have been received the appellation "pork barrel."⁴⁹ It should also be noted that tributary projects were frequently authorized on the basis of general economic development of a region, rather than actual returns in the form of benefits to navigation computed per ton-mile of commerce; and from this standpoint benefits were often amply realized.

"Pork barrel" policies were revised during the Progressive Era of the early twen-

tieth century. In 1910, for example, President William H. Taft declared: "The proper policy . . . is to determine from the many projects proposed and recommended what are the most important, and then to proceed to complete them with due dispatch; and then to take up others and do the same thing with them."⁵⁰ This suggested reform in waterways legislation was adopted; funds were concentrated on completing major through-waterways projects; and tributaries were then improved on the basis of existing demands and needs of traffic, rather than a general developmental basis.

CHAPTER X: ORIGINS OF OHIO RIVER CANALIZATION, 1870-1910

The construction of a lock and dam, canalization project on the Ohio River was first recommended by William Milnor Roberts and other engineers a decade before the Civil War; and Roberts, as Superintendent of Ohio River Improvements, reiterated his recommendation in 1870. Though open-channel improvement of the Ohio was to continue until the completion of the slackwater project, the major development of interest on the Ohio in the late nineteenth and early twentieth century was the Ohio River Canalization Project. Construction of the canalization project began, under the direction of Colonel William E. Merrill, at Davis Island Lock and Dam (No. 1) just below Pittsburgh in 1878. The basic engineering-construction methods and structural features of the project to provide a dependable navigable depth on the Ohio River were first devised, constructed, and tested at Davis Island. The Davis Island project opened to navigation in 1885, and after it had been operated successfully for several years additional locks and dams were constructed to provide a six-foot minimum depth on the Upper Ohio. And in 1910 Congress authorized a project to provide a nine-foot navigable depth throughout the length of the Ohio River.

During this period, 1870-1910, the only permanent navigation structure on the Lower Ohio was the canal and dam at Louisville, and the authorized project for that river section was a continuation of the time-honored methods of channel clearance, excavation, and dike construction. But the history of the development of the Ohio River Canalization Project on the Upper Ohio is also important in understanding the history of the Louisville Engineer District, for the project on the

upper river set the pattern for the work of the Louisville District after 1910. In addition, personnel of the Louisville District were also involved in the early planning and construction of the canalization project.

The down river progress of the canalization project on the Ohio prior to 1910 was slow, agonizingly so to navigation and commercial interests in the Ohio Valley, for "pork-barrel" federal waterways policies of the era limited the funds available for the Ohio River. And the Army Engineers proceeded cautiously, testing theories against experience, modifying the project as technological advances, actual operations, and waterborne commerce development proved necessary, convincing skeptics who questioned both the practicability and advisability of the project, and conciliating conflicting waterways and political interests. Though slackwater projects had been completed on tributaries of the Ohio and though European waterways engineers had developed movable dams, there were actually no precedents for the slackwater improvement of a stream the length and breadth of the Ohio.

The Roberts Survey, 1867-1870

It will be recalled that W. Milnor Roberts was appointed Superintendent of Ohio River Improvements in 1866 and that he made a preliminary examination of the river in that year. In 1867 he commenced a detailed survey of the river, beginning work where the Sanders survey had ended (271 miles below Pittsburgh) in 1844. Two survey parties, under Alonzo Livermore, former project engineer on the Green and Barren rivers, and Sigismund Low, an experienced railroad construction

engineer, descended the river in flatboats, while Roberts, his son Thomas P. Roberts, and Captain George Rowley traveled the river in the steamboat *Major Sanders* surveying shoals for dike construction. Though the survey parties suffered terribly from malarial fevers, the survey was completed in 1869, furnishing the first complete and accurate information about the hydrology of the entire river on 118 hand-drawn charts.¹

During the course of the survey, Roberts noted that beacon lights were urgently needed to guide navigation through the narrow, rocky channel at Grand Chain on the Lower Ohio, and he officially recommended to Congress that they be provided. The United States Lighthouse Service had been established by Congress in 1852, but its activities were limited to coastal and Great Lakes harbors. Prior to 1869, boat pilots on the inland rivers depended upon recognition of topographic features — bluffs, tall trees, farm houses, and so forth — as a guide to channel location. No action was immediately taken on Roberts' recommendation, and the Louisville Pilots Association acted independently, in October, 1869, placing oil lamps on the Illinois bank at the head and foot of the Grand Chain, which were probably the first beacons for navigation on the inland rivers. At continued urging of the Corps and the river interests, the functions of the Lighthouse Service were extended to the inland rivers in 1874. It installed about 150 beacons and buoys on the Ohio River in 1875.²

*Renewed Improvement of the Ohio,
1867-1870*

While completing the detailed survey of the Ohio, Milnor Roberts had two other duties to perform: removal of all movable obstructions from the channel and con-

struction of dikes at points most likely to benefit low-water navigation. He entered into contract with several firms for repair and construction of dikes, and contracted in 1867 with Commander John Rodgers, owner of the wrecking steamer *Greenback*, for removal of snags and wrecks. In 1868 he also chartered two additional wrecking boats, the *Zebra* and *Petrolia*. The character of open-river improvements had not changed significantly since the days of Captain Shreve, as the report of the operations of the *Petrolia* at Hurricane Island above Paducah, Kentucky, in July, 1868, indicated:

We arrived at this place in good season. There were one hundred snags in the water here, all with their ends in sight above water; they are deeply imbedded in the sand and mud; unfortunately the river is raising again . . . and we may not be able to reach all. We will take out fifty of the worst snags here, and cut them up on the river bank, if the water permits. The snags are all very heavy, and have to be cut up into short pieces and taken to the bank . . . The average size of the snags is from 2½ to 5 feet through at the butt, and from 60 to 120 feet in length, and are mostly tough wood . . . One that we took out, a monster pecan, was 5 feet in diameter and 120 feet in length. We worked at this snag four days, it being solid as mahogany, breaking chains and wearing out saws, but we succeeded in getting entirely rid of it.³

Milnor Roberts accepted a position as chief construction engineer at Eads Bridge across the Mississippi at St. Louis in 1870. He later surveyed routes across the Rockies as Chief Engineer of the Northern Pacific Railroad, served as president of the American Society of Civil Engineers, and, at his death in 1881, was chief engineer of all rivers and harbors projects in Brazil. Before departing the Ohio River, he completed an analysis of commercial and hydrologic data and officially recommended the adoption of a canalization project to provide reliable navigable depths.⁴



COLONEL WILLIAM E. MERRILL

Cincinnati and Pittsburgh District Engineer 1870-1891

Louisville District Engineer 1884-1886

Colonel William E. Merrill, Corps of Engineers, assumed charge of Ohio River Improvements, except for the Falls and Louisville canal, on June 17, 1870. Colonel Merrill, the son of an officer who died in action during the Mexican War, had received his early education at Louisville. As a cadet at West Point — he graduated first in the Class of 1859 — he received the nickname “Padre” because of his fondness for foreign languages and his high standards of personal integrity. (It will be recalled that he resigned as Louisville District Engineer in 1886 rather than submit to political interference.) “Padre” Merrill had directed military construction and combat engineering in the Ohio Valley during the Civil War, and had served on General Sherman’s staff until appointment to the Ohio River project. In 1871, after Colonel John N. Macomb and the Office of Western River Improvements transferred from Cincinnati to St. Louis, Colonel Merrill moved the Office of Ohio River Improvements from Pittsburgh to Cincinnati, where supervision of work on the Ohio would be more centrally-located.⁵

Most work on the Ohio under the direction of Roberts at Pittsburgh had been concentrated on the Upper Ohio. Merrill extended operations to the lower river, contracting for such work as the repair of Cumberland Dam at Smithland and the removal of Baccus Rock, Jackson Rock, and other obstructions at the Grand Chain. He also concluded that the contracting wrecking steamers were unsatisfactory, as the four days taken by the *Petrolia* to remove a single snag perhaps proved, and initiated construction of an Engineer floating plant for use exclusively on the Ohio.⁶

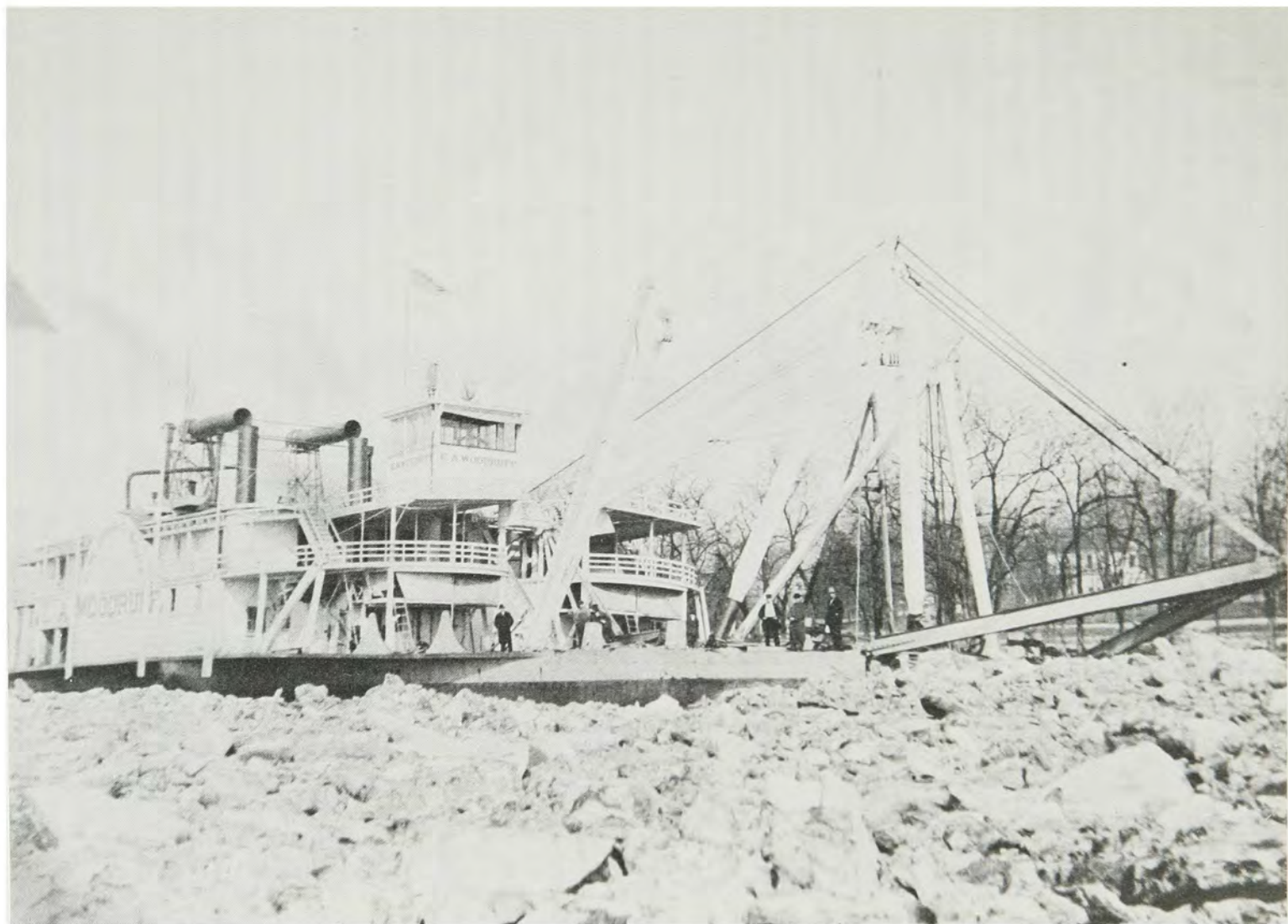
New Floating Plant, 1870-1876

Colonel Merrill and his staff studied in-

land river watercraft, concluded that wooden hulls were not sufficiently durable for the hard-service of river improvement, and arranged the construction of a snagboat with an iron hull. Merrill believed an iron hull might last as long as fifty years; whereas, wooden hulls were seldom useful after ten-years service. A few iron-hulled vessels had been constructed for private concerns prior to 1870, but the advantages of such hulls were not generally understood.

The iron-hulled snagboat *E. A. Woodruff* was built at Covington, Kentucky, in 1875. It had a wide, flat-bottomed hull with a broad stern and a double bow, aptly described as shaped like a “boot-jack,” had a Shreve snag-beam between the double-bows at the waterline, and handled snags with relative ease. To dispose of submerged wrecks, Merrill designed a huge, 1½-ton grapple which the *Woodruff* dropped onto wrecked vessels and dragged back and forth to tear them to pieces. First master of the *Woodruff* was Captain George Rowley, but its best-known master was Captain William H. Christian who commanded the vessel for about a quarter-century. The *Woodruff* operated on the Ohio for as long as a separate project for open-channel improvement existed. In 1925, after fifty years service, it was sold to the Greene Line, which used it as a wharfboat at Louisville until 1940.⁷

Colonel Merrill also put the steam dredge *Ohio* into operation in 1872 and the dredge *Oswego* in 1874. They were operated at costs considerably less than previous contract work. Each was eventually given an iron hull, and, like the *Woodruff*, became fixtures on the river. The *Ohio* operated until 1950, almost eighty years, and its hull was still in use in 1970. The *Oswego*, after a century of ser-



U. S. Snagboat E. A. Woodruff caught in ice jam, 1918

vice, was still dredging for a private company on the Monongahela River in 1970.⁸

Until the Ohio River Canalization Project was completed, the project for improving navigation with the methods developed by Captain Henry Shreve and Colonel Stephen Long continued. Though these methods frequently were of considerable benefit to light-draft vessels, their effects were seldom permanent and they could never have provided an adequate depth for heavily-laden barge traffic. New snags formed after every high water and the increased depth provided at a particular shoal by dike construction often resulted in decreased depths on downstream bars where dislodged materials again settled. Colonel Merrill summarized the problems attending open-channel improvements in 1879:

It is always a difficult and embarrassing matter to submit an estimate on a great river like the Ohio. All rivers contain a series of bars or shoal places over which less water can be carried than elsewhere, and the object of all works of river improvement is to add to the paying tonnage of river craft by increasing depths on these bars. On the Ohio there are two hundred well-defined bars, and many others with which navigators do not now concern themselves, but which will become prominent in case the better known bars are deepened.⁹

Slackwater Project Planning

W. Milnor Roberts commented in 1870 that the open-channel project on the Ohio, "although it will be productive of public benefit more than commensurate with the outlay required, it will be no more than an amelioration of the present difficulty." He declared that only construction of a canalization, lock and dam project on the Ohio could effectively meet hydraulic exigencies and navigation requirements. He recommended a slackwater project to secure a six-foot minimum navigable depth from

Pittsburgh to Cairo, involving the construction of sixty-six locks and dams at estimated costs of \$23,777,662. The Roberts plan was to construct a low fixed dam across the river at sixty-six locations. To pass traffic, each dam would have two locks (maximum chamber dimensions of 370 by 80 feet) and a 300-foot wide chute, closed with movable "shutters" at low water, in the crest of each dam. The "great desideratum" for the Ohio River, he asserted, was a constant, reliable navigation. But he predicted:

Objections will be made to the adoption of any plan, some of which objections may be well founded; because it is hardly to be supposed that either plan, in its construction, will not injuriously affect, more or less, some private interest, private views, and present private arrangements. No great scheme designed for general public benefit ever yet escaped objections of some sort.¹⁰

Concerted efforts were undertaken by state governments after the Roberts report to gain congressional support for a canalization project on the Ohio. The legislature of Kentucky, for instance, on February 9, 1872, instructed the Kentucky congressional delegation to support canalization of the Ohio, and Kentucky joined with Pennsylvania, Indiana, Ohio, West Virginia, Illinois, and Tennessee in participation in the regional Board of Commissioners for the Improvement of the Ohio River (Ohio River Commission). Members of the Commission studied the economic and transportation situation on the Ohio Valley, met with Colonel William E. Merrill and other Army Engineers to learn the details of the proposed slackwater project, and actively lobbied for the project in Washington.¹¹

Colonel William E. Merrill of Cincinnati District and General Godfrey Wetzel of Louisville District were appointed on April 16, 1872, as a special Board of En-



U. S. Dredge Ohio pulling a snag out of the Ohio River

gineers to report on canalization of the Ohio. The two officers studied European waterways engineering, solicited proposals for movable gate designs for use in the chutes for coal-tows recommended by Milnor Roberts, and set up their own experimental station to test models of hydraulic gates. After experiments with a number of gate devices, the Board found that a hydraulic gate designed by F. R. Brunot of Pittsburgh might meet the requirements and recommended that a full scale experiment be authorized. At that time, the Monongahela Navigation Company was experiencing difficulties; huge fleets of coal barges gathered in the pool of Lock and Dam No. 1, a fixed structure on the Monongahela, to await a rise in the Ohio before descending to market, and because of limited lock capacity the tows often failed to pass the lock in time and necessarily were delayed until the next rise. The President of the Monongahela Navigation Company offered the use of Dam No. 1 for the experiment with the movable gate and chute, and also offered to pay half the cost of the experiment. Merrill and Weitzel suggested that this offer be accepted, but Congress took no action because of strong opposition from coal shippers to locks and dams on the Ohio.¹²

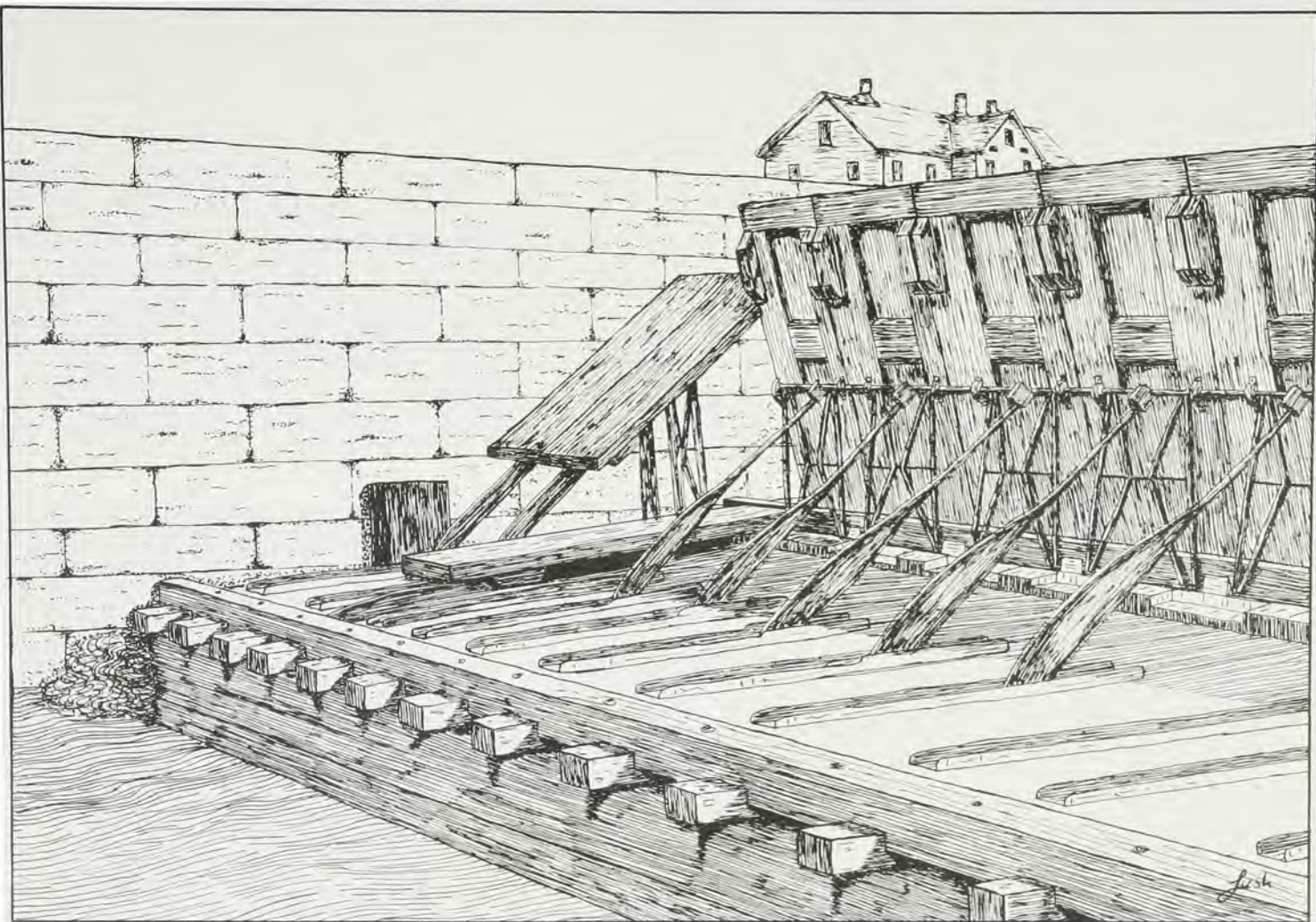
Movable Dam Adopted

Over fifty million bushels of coal annually descended the Ohio from Pittsburgh on "coal rises" of seven foot or more in 1874. It was transported in fleets of eight to twenty barges bound tautly to a steam towboat by a complex system of cables and chains. Delays ensued anytime separation and reassembly of tows was required, and coal shippers preferred the Ohio be left in its natural condition to the delays attending lockage. Nor were they

pleased with the plans for gate-controlled chutes in the crest of dams, for practically the entire channel width was required to maneuver the ponderous tows in "flanking" movements. Coal shippers, with the single exception of Captain John A. Wood, vigorously opposed canalization of the Ohio, and in their campaign against the project they resorted to allegations that the dams might increase flood heights, that stagnant slackwater pools would be a health hazard, and that the project would result in filling the river channel with silt.¹³

These objections had to be answered before Congress would authorize the canalization project. Insofar as the charges of increased flood heights, health problems and channel silting were concerned, proponents of the project had only to point to the successful slackwater projects in operation on the Monongahela, Muskingum, Green, and Kentucky rivers. But some method had to be devised to permit open-river navigation by the immense coal tows at higher water stages. Colonel Merrill and his associates found the answer in movable dams, which in raised position would form navigable slackwater pools but which could be collapsed against the bottom of the river at high water.

Addison M. Scott, Assistant Engineer on the Kanawha River project, had visited Europe about 1870, observed movable dams on rivers in France (designed and constructed by Monsieurs Chanoine and de Lagrené of the Corps des Ponts et Chaussées), and recommended their use on the Kanawha. Colonel Merrill and his assistant, Lieutenant Frederick A. Mahan, also thought movable dams, if modified to meet special conditions of the Ohio, might be usable, and they visited France to examine the projects on the Seine, Yonne,



Chanoine Wickets at Davis Island Dam—Ohio River

Marne, and Meuse, and studied French engineering journals, while General Weitzel reviewed German waterways engineering. In 1874, Colonel Merrill recommended that movable dams, utilizing Chanoine wickets, be adopted for canalization of the Ohio.¹⁴

The Chanoine wicket, invented by Jacques Chanoine in 1852, made a movable dam possible. Chanoine wickets hinged to a concrete foundation on the bottom of the river, were aptly described as resembling large folding boards, about three feet, nine-inches wide and twelve feet long; eventually, on the Lower Ohio, much longer wickets were developed to increase slackwater pool depths and reduce the number of dams necessary for the project. To the back of each board was attached a metal framework, called a "horse," with a metal prop to hold the wicket in an upright position.¹⁵

At high water levels, the wickets lay flat on their foundation on the riverbed and opened the channel for navigation; when the river level dropped, a crew of men on a special maneuver boat hooked a grapple and cable to the top of a wicket and raised it, pulling the prop behind it along a groove in the foundation known as a Pasqueau hurter. When the wicket was released, water pressure forced it back and the prop slid down the hurter, or groove, to catch in a niche and hold the wicket upright. The maneuver boat then moved to the next wicket, repeated the process, and so on across the channel until all wickets were up to form a dam and provide a slackwater pool. At extreme low water the three-inch spaces between each two wickets were closed with pieces of wood, called "needles."¹⁶

Colonel Merrill recommended movable Chanoine dams in 1874 because they would meet the needs of coal-towing in-

terests for open-channel navigation and at the same time provide slackwater pools at low-water. He also recommended that locks be 75 feet wide and 630 feet long to pass ten barges, a tow-boat, and a fuel flat at a single lockage. Swinging mitering lock-gates, hanging from supports on lock walls, could not, in the opinion of Colonel Merrill, be effectively operated in a lock wider than 75 feet. But coal shippers protested that 75 feet was still too narrow for the ordinary tow, without breaking and reassembling the barges before entering the lock, and Merrill subsequently designed a new type of lock-gate — a rolling gate mounted on wheels which rolled on tracks from one side of the lock to the other — to permit increasing lock width to 110 feet. He and a Board of Engineers then recommended that a 110- by 600-foot lock and movable dam be constructed at Davis Island, five miles below Pittsburgh, as an experiment to test the effectiveness of the plan and provide an improved harbor for the "Steel City."¹⁷

Politics and Authorization

Coal shippers denounced the project as a "damnable move," organized torch-light processions and similar demonstrations against it, warned the public that the project would cause pestilence, and would be ruinous to the coal trade and related industries. Colonel Merrill responded that coal-barging then constituted only about five percent of the value of the total commerce on the Ohio and should not hold up a project to benefit all commerce; pointed out that modifications had been made to meet the requirements of coal shippers; and declared that canalization of the river would facilitate a constant coal supply to consumers, preventing alternate coal-gluts and coal-famines. He asserted:

The advantage to consumers would be incalculable. At present there is not a large manufacturing establishment on or near the Ohio and Mississippi Rivers that is not compelled to keep on hand at all times a large stock of coal for which it has no immediate use, but which it must retain for fear of low water and a consequent coal-famine, although it is well known that coal rapidly deteriorates when exposed to the weather. The advantage of being able to buy the barge-load coal fresh from the mine, in quantity as needed, would be worth millions to the industry of the Ohio Valley.¹⁸

But the coal shippers were not to be mollified; they pressured members of Congress to oppose appropriations for the project and opposed granting the necessary jurisdiction over the Davis Island site to the United States in the Pennsylvania legislature. But the project also had influential support from the Ohio River Commission and, indirectly, from the Grange, a national farm organization which wanted cheaper transportation and supported waterways for that purpose and as competition for rail lines.

The Senate Committee on Transportation-Routes to the Seaboard (commonly known as the Windom Committee) held hearings on the Ohio River Canalization Project in 1873 and 1874 as part of its broad review of transportation problems. The Committee, which was dominated by the influence of the Grange movement, heard testimony from Colonel Merrill and Captain Milton B. Adams, deputy to General Weitzel. It reported that, though, railroads had been completed from the Ohio Valley to the Gulf, the waterways were still the "cheapest line of transport" and the competition of waterborne commerce forced the reduction of railfreight rates. Along with a number of other waterways projects, in 1874 the Committee recommended congressional authorization of the Ohio River Canalization Project, commenting in its report:

The improvement of the Ohio River in such a manner as to secure from Pittsburgh to Cairo a depth of 6 feet of water at all seasons is believed by the committee to be one of the most important works for which the National Government can appropriate money.¹⁹

Congress appropriated \$100,000 for land acquisition and initial construction of the experimental movable dam and lock at Davis Island in 1875. Colonel Merrill could not commence construction, however, until jurisdiction over the site had been granted by Pennsylvania and opposition of the coal men to the project prevented the enactment of such legislation for several years. The Pennsylvania assembly passed the jurisdiction bill in 1874, but it was vetoed by the Governor. It passed the lower house again in 1875 and was sent to the state senate, where it mysteriously disappeared and the legislature adjourned without acting upon it. In 1876 the coal interests arranged its defeat, but the Pittsburgh Chamber of Commerce, which wanted an improved harbor, took special interest in the legislation in 1877 and it was enacted.²⁰

Davis Island Project: The Pattern

Construction of the Davis Island project commenced in 1878 and was completed in 1885; seven years were required because of limited funding and the experimental character of the work. The cofferdams used at the project were wooden frame boxes filled with loam excavated on Davis Island; a concrete foundation for the dam was poured and a timber framework embedded in the concrete to which the wickets and other appliances were bolted; lock walls and piers were built of ashlar masonry laid in Louisville hydraulic cement. And great care was taken to maintain minute records of costs and various construction methods to establish a fund

of engineering information for future projects. For example, in designing the chain and drum apparatus to be used in operating the lock-gates, Colonel Merrill consulted a number of authorities, including Commander George Dewy, U.S. Navy, who had considerable experience with a similar device for weighing ship anchors.²¹

The 110-foot wide and 600-foot long lock was, when completed, the largest lock in the world, and was not exceeded in width by even the ship locks of the Panama Canal. As previously mentioned, the rolling lock-gates were an original design of Colonel Merrill to compensate for the great width of the lock chamber. They were essentially Howe trusses built of pine timbers and mounted on metal axles and wheels. Each 117-foot long lock-gate was housed in a recess in the landward lock-wall when not in use; to close the lock, the gates were pulled across the lock on tracks set in the foundation by chains winding on drums powered by steam engines and water turbine wheels.²²

The movable dam, also the largest in the world at the date of completion, totaled 1,223 feet long; it actually was 305 little dams — the number of Chanoine wickets in the navigable pass and three weirs. The 559-foot wide navigable pass was, as the name implies, the place where the wickets were lowered for navigation to pass across the dam when the river was high. The three weirs, also, constructed of Chanoine wickets on a concrete foundation, were raised and lowered to regulate the level of the pool above the dam. Wickets in the navigable pass were raised and lowered by a maneuver boat; wickets in the weirs were operated from a collapsible service bridge installed just upstream of the wickets.²³

On October 7, 1885, an elaborate cere-

mony was held to open the \$910,000 Davis Island project to navigation. A procession of thirty-nine steamboats crowded with congressmen and prominent citizens of Pittsburgh and other Ohio River ports steamed down river to the lock, to the cheers of a crowd along the banks, estimated to number as high as 50,000, and to booming cannon salutes. The occasion was marred, as such ceremonies often are, by accidents. A cannon firing salutes fired prematurely, blowing off the hands of the rammer and seriously injuring several spectators, and when the fleet arrived at the lock a problem had developed with operation of the lower lock-gate. Boats entered the lock and it was emptied and filled, but they could not pass through. The last orator of the occasion was Colonel William E. Merrill. He expressed his appreciation to all who had supported the project, and said:

Let us hope that this celebration is but the forerunner of many similar ones until our beautiful river becomes the permanent home of a steady and beneficial commerce, and the ancient slur that it is "dry all summer" fades away into oblivion.²⁴

At precisely noon, the Colonel's son raised the flag of the United States over the project, signaling the opening of navigation. As the colors billowed, Colonel Merrill proclaimed: "In the name of the United States, I now declare the Davis Island Lock and Dam to be open to navigation. *Esto perpetua.*" On the following day the locks were in order and the first boat passed through. It was, perhaps appropriately, a little market boat burdened with Ohio Valley produce.²⁵

Davis Island Project: Operation

Colonel Merrill wisely recommended holding construction of further locks and dams on the Ohio in abeyance until ex-



Ohio River—Wicket raising operation

perience was gained in operating the first project. And there were several valuable lessons learned by the Corps at Davis Island which influenced the design of down-river locks and dams. The service bridge for operating the weirs at Davis Island was eliminated from subsequent projects because it was damaged by barges on several occasions and was practically destroyed by the debris which descended the river on the crest of the Johnstown Flood of 1889. Maneuver boats were used to operate both navigable pass and weirs on later projects. Also as a result of the damages caused by debris in 1889, an automatic bear-trap weir was installed to permit passage of debris. In operation, it was discovered that controlled use of the bear-trap weir facilitated regulation of the pool during small rises and reduced the amount of labor necessary to raise and lower the Chanoine wicket weirs. The first bear-trap was constructed of wood, similar to those used in the Beattyville project on the Kentucky River in 1884, but they were damaged in 1891 when a stable caught on fire at Pittsburgh and burning hay was thrown into the river. Subsequent bear-traps were constructed chiefly of metal.²⁶

Many problems were also experienced with the novel rolling-gates. Axles broke, wheels broke, chains broke, and the lock-gate recesses filled with silt. Better methods were devised for sealing and cleaning the recesses during high water; the original wooden gates were replaced by metal gates; all movable parts of the gates were strengthened; and, in spite of all the problems attending rolling-gate operation, the improvement made at Davis Island permitted their continued use until the Louisville Engineer District designed a mitering-gate in 1916 which would operate satisfactorily in the 110-foot

wide locks. Another problem solved at Davis Island was scour, or erosion of the riverbed, below the dam. Barges loaded with rock were sunk below the dam to remedy the problem and each dam constructed on the Ohio thereafter was protected by the placement of heavy riprap stones on the downstream side.²⁷

Successful operation of the Davis Island project quickly quelled all previous apprehensions. The greater depth of water in the Pittsburgh harbor was credited with improving public health by reducing the problems attending the disposal of sewerage effluents. Increased water supply during dry summer months was also of inestimable value to riverside industry. And the coal shippers became great proponents of extension of the canalization project, because the pool formed by Davis Island Dam provided plenty of room for arranging tows and the traffic no longer had to await a river rise behind Lock No. 1, Monongahela River. During an unusual flood in July, 1888, about a hundred coal barges were wrecked on the Monongahela, but not one in the Davis Island pool went down; coal shippers claimed the project saved property worth more than the costs of construction during this single incident. The Davis Island project served Ohio River commerce for thirty-seven years, until replaced by Emsworth Lock and Dam in 1922.²⁸

The Six-Foot Project, 1885-1910

Congress authorized a study of an extension of the six-foot minimum-depth slackwater project down the river in 1888. A Board of Engineers, consisting of Colonel Merrill, Cincinnati District Engineer; Major Amos Stickney, Louisville District Engineer; and Major Alexander Mackenzie, former deputy to General Weitzel at Louisville, held public hear-

ings which revealed the coal and navigation interests unanimously favored the construction of more locks and dams. The Board reported favorably on establishing a six-foot channel depth from Davis Island to just below the mouth of the Beaver River.²⁹

Lock and Dam No. 6, named Merrill Dam in honor of the "Father of the Ohio River Improvement," was the second of the series constructed. The first appropriation for Merrill Dam was made in 1890, but funding was slow and the project was not completed until 1904. The first appropriation for Locks and Dams Nos. 2, 3, 4, and 5 was not made until 1896, and then only after navigation and commercial interests in the Ohio Valley had organized the Ohio Valley Improvement Association (OVIA) in 1895 to remedy congressional "neglect" of the river. In 1896 the OVIA took the House Rivers and Harbors Committee on a grand tour of the Upper Ohio River, its coal mines, and other industry to provide the congressmen with a first-hand knowledge of the needs of Ohio Valley commerce.³⁰

Citizens of the Ohio Valley below the authorized canalization project became eager for extension of the project to river sections serving their localities. In 1899 canalization of the river to Marietta, Ohio, at the mouth of the Muskingum River was authorized, bringing the number of approved locks and dams to eighteen. Funds were first provided for Locks and Dams Nos. 13 and 18 of the additional structures to furnish harbors for the port cities of Wheeling and Marietta. In 1902 canalization of the Ohio to the mouth of the Miami River, just below Cincinnati on the Ohio-Indiana state line was approved; the Corps recommended that locks and dams be first constructed below the port cities of Cincinnati, Point Pleasant, Gallipolis,

Parkersburg, Catlettsburg, and Portsmouth, in that order, and, as a result, the first lock and dam of the series to be constructed in the present Louisville Engineer District was No. 37 below Cincinnati.³¹

Construction of a lock and dam below Evansville and Henderson to provide a harbor for those ports and to aid traffic from the Green River was studied, and this study plainly indicated that a decision on the advisability of completing the slackwater project throughout the length of the Ohio River was in order. General Alexander Mackenzie, Chief of Engineers, observed that two locks and dams (Nos. 1 and 6) were completed, seven were under construction in 1904, and five more were funded. To construct a lock and dam below Henderson (No. 48) would commit the United States to completing the canalization of the river at least that far. In the opinion of the Chief of Engineers, a full-scale review of the project was required before additional commitments were made.³²

There was another problem which had been raised on the upper river. Major William L. "Goliath" Sibert, who had begun his civil works career on the Green River project and served as Louisville District Engineer, 1900-1901, directed construction of Locks and Dams Nos. 2-6 as Pittsburgh District Engineer. Studies indicated that the six-foot project, though satisfactory for the dwindling steamboat packet trade, was inadequate for the deep-draft barge-towing system, and Major Sibert recommended raising the first six dams to provide a nine-foot channel. The nine-foot depth for the first dams of the series was approved by Congress in 1905.³³

Thus, by 1905, three problems had to be resolved before the Ohio River Canaliza-

tion Project was continued. First, should the project be extended to the Lower Ohio River, or could the commerce of the lower river be adequately served by a continued open-channel improvement project; second, what might be the relative costs and benefits of a nine-foot navigable depth as compared with a six-foot project; and third, with commerce on the Ohio, and on the inland rivers in general, declining, would continuation of the canalization project be economically justified?

The Lockwood Board

To review these questions, Congress directed the appointment of a Board of Engineer officers in 1905. This Board, called the "Lockwood Board" because its senior member was Colonel Daniel W. Lockwood, had all Ohio River District Engineers as members. It conducted its broad review of the canalization project in 1905 and 1906, touring the river aboard the *Major Mackenzie* to view actual conditions and holding hearings at Pittsburgh, Cincinnati, and Louisville. Typical of the testimony presented to the Board was that of the Louisville Board of Trade:

With a deep and uninterrupted river the number of steamboats and barges would multiply one hundred fold. The cost of a steamboat is large and people will not at present invest money to a great extent in a property that can work only one-half the time. With open river the year round the boats and barges would quickly come and shippers would patronize them, for contracts could be made for future deliveries with a knowledge that the river would be open and delivery made. With deep water and uninterrupted navigation from Pittsburgh to New Orleans and the opening of the Panama Canal Louisville and the whole Ohio Valley can send the products of their factories and fields into good foreign markets.³⁴

At the time of the Lockwood Board investigations it was evident that waterborne commerce on inland rivers was de-

clining; on the Ohio the steamboat packet trade was experiencing serious losses, though the growing coal trade kept actual tonnage at a high level. The general decline on waterways was attributed to many causes: to railroad competition and deliberate efforts by railroad management to destroy its waterways competition, to inefficient management of the steamboat business, and to way charges collected at port cities for wharfage. The Lockwood Board concluded, however, that the cause of the proportional decrease in waterborne commerce was the "unreliability" of navigation on unimproved streams. Its studies indicated the commercial and natural resources of the Ohio Valley were sufficient to require reliable waterways service in addition to railroad facilities. It also found that the completed project section on the Upper Ohio had stimulated a "remarkable" industrial development at riverside, and it predicted that similar development might be expected on downstream sections were the river canalized.³⁵

National waterways policies were in transition at the time the Lockwood Board conducted its studies. There was growing public concern about the "decadence" of American waterways, as compared with the high level of development and utilization of European rivers. This concern was partly expressed by the organization of the National Rivers and Harbors Congress in 1901 to promote waterways projects and the increased activities of the Ohio Valley Improvement Association.

The OVIA, for example, in 1905 arranged a tour of the Ohio Valley by the House Committee on Rivers and Harbors and the Lockwood Board of Engineers. The group was assured by Louisville newspapers, on their arrival at the Falls City on May 15, that the motto in the Valley was: "Dredge and dam the Ohio river

so as to insure a nine foot stage of water the year round." The group was addressed that evening by Will S. Hays, the seventy-year-old balladeer and river reporter, who told them:

God Almighty gave you the Ohio river, and if you fellows can't raise enough money at Washington to improve what God Almighty gave you, you are a poor lot. I hope and I feel sure that Congressmen will open their hearts and give the Ohio River what it needs. I trust that no one of you will have a grandson who will look upon the Ohio and say that it may be locked, but it isn't worth a dam.³⁶

The Kentucky legislature expressed its support for the canalization project in 1906, pointing out that federal appropriations for waterways projects had averaged less than twenty million dollars annually during the previous decade and were "wholly incommensurate with the great interests involved." The legislature resolved that Congress adopt a "broad and liberal" policy of providing fifty million dollars for water ways annually and instructed the congressmen from Kentucky to support such a policy.³⁷

Reform of "pork barrel" waterways policies was a dominant issue during the administrations of Presidents Theodore Roosevelt and William H. Taft, 1901-1913. Hundreds of protests against "pork barrel" policies were printed in the newspapers and journals of the era. For example, the editor of *Engineering News*, an influential professional journal, wrote in 1909:

It is the system that is radically at fault, rather than the men who have administered the system. The individual officer of the Corps of Engineers is powerless to effect a change and the individual Congressman is almost as helpless. The public has not in the past and does not to-day look to the Corps of Engineers to originate or recommend plans for waterways improvement. It does not even welcome the advice of these engineers in reporting upon offered projects. Each city and district wants to boom the waterway schemes in its own locality; and many an engineer officer has

made himself unpopular because he could not as an engineer approve some of the schemes brought forward in the district.

The root of the difficulty with our internal waterway development of the past is that it has been a matter of haphazard growth. The engineer has seldom had a chance to plan on broad lines and when he has made plans there has been no assurance that the plans would be carried out before the whole work became obsolete.³⁸

The first step toward reforming "pork barrel" policies was taken in 1902; the Corps created the Board of Engineers for Rivers and Harbors, a national board to review all projects independent of any local political influences. Under the reform leadership of Chairman Theodore H. Burton, the House Rivers and Harbors Committee adopted the policy in 1907 of declining consideration of any project which did not have the prior approval of the Corps of Engineers. And the Inland Waterways Commission, created by President Roosevelt in 1907, was the first of several executive committees which investigated and recommended sweeping revisions in waterways systems policies.³⁹

In this atmosphere of growing concern with diminishing use of inland waterways and reform in national waterways policies, the Lockwood Board completed its investigation of the Ohio River Canalization Project. On December 15, 1906, the Board reported that a project to establish six-foot navigation from Pittsburgh to Cairo would cost \$50,962,266, as compared with a cost of \$63,731,488 for a 54 lock and dam system to provide nine-foot navigation. It estimated the probable cost per ton-mile for a six-foot project would be .0653 cents and for a nine-foot project would be .0447. The nine-foot project showed an estimated economic advantage in the ratio of 3 to 2, while construction costs would be greater in a 6 to 5 ratio. The Board therefore recommended adoption of a nine-foot

project for the entire course of the Ohio, the principal thrust of project rationalization being:

Having in view the fact that a canalized river offers an upstream navigation lower in cost and quicker in transit than an open-river project, the Board, arguing from the known natural resources of the section and its population, concluded that a river improved by this method will afford facilities for the cheap exchange of mineral, agricultural, and manufactured commodities, which from their low value and bulk cannot be exchanged unless such cheap facilities are offered, and that there is every probability that the improvement of the Ohio River by canalization, as proposed, would induce a very large future commerce which does not now exist in addition to retaining and greatly facilitating and cheapening the commerce which the river now bears.⁴⁰

The Board of Engineers for Rivers and Harbors made a personal inspection of the river, held additional public hearings, re-studied the recommendations, and concurred with the Lockwood Board report. It concluded that, though the Ohio River project was "on a scale not hitherto attempted in this country," the Ohio River was the one river above all others "most likely to justify such work."⁴¹

The Chief of Engineers pointed out the project was based upon a "conjectural future commerce" of thirteen million tons annually. Though the Lockwood Board was convinced that the probability of increased traffic was sufficiently strong to justify the large expenditures for the proposed project, Congress had not previously sanctioned a project of similar scope, and the Chief of Engineers preferred not to recommend the project, and to leave it to the "wisdom of Congress."⁴²

And there were those who questioned the project rationalization based on projected future commerce. The editors of *Engineering News*, for example, stated that the Ohio River Canalization Project was "bound to be a losing one." President

William H. Taft, however, threw his support to the project, commenting:

It seems to me that in the development of our inland waterways it would be wise to begin with this particular project and carry it through as rapidly as may be.⁴³

Congress authorized construction of a nine-foot slackwater project on the Ohio to its mouth, as recommended by the Lockwood Board, in the Rivers and Harbors Act of June 25, 1910. Its determination to avoid the pitfalls of previous "pork barrel" policies was indicated by the stated intention to furnish funds at a rate sufficient to complete the project in twelve years; that is, by 1922. Nevertheless, the first appropriation for land acquisition and initial construction for a project estimated to cost over \$63,000,000 was only slightly more than one million dollars; unless the amounts provided in subsequent legislation were substantially greater, it was evident that the twelve-year deadline could not be met.⁴⁴

Summary

Though the Army Engineers on the Ohio made several advances in floating plant design and engineering methods, the open-river channel improvement project on the Ohio could only lengthen navigation for a few months each year. Open-river improvements could never have provided a dependable depth for year-round navigation. Immediately after the Civil War, the Corps initiated studies of other improvement methods and selected the slackwater, lock and movable-dam method as the one most likely to meet commercial requirements and hydrologic conditions on the Ohio. Under the direction of Colonel William E. Merrill, the "Father of the Ohio River Improvement," an experimental lock and movable dam was completed just below

Pittsburgh in 1885, and its successful operation convinced the skeptical of its value and led to increased support for extension of the slackwater project to provide reliable navigation on the entire length of the Ohio.

Studies completed at the turn of the century indicated that a nine-foot navigable depth, instead of the six-foot depth provided by original structures, would be more serviceable and economical for the deep-draft barge-tows handling low-value bulky commodities on the waterways. And in 1905 comprehensive studies of existing and potential commerce on the Ohio, the feasibility of canalizing the entire river, and the comparative advantages of six- and nine-foot projects commenced.

These studies came at a time when the steamboat packet business in the inland rivers was entering its final phase, when commerce on inland waterways was pro-

portionally diminishing, and when federal waterways policies were being reconsidered. The Lockwood Board predicted that canalization of the Ohio to a nine-foot navigable depth would provide dependable navigation for the movement of bulky industrial materials, would stimulate industrial development in the region, and would thereby lead to a revitalized commerce on the river. A number of skeptics did not agree, arguing that construction of the Ohio River Canalization Project would never provide benefits commensurate with costs. But Congress authorized the nine-foot project on the Ohio in 1910. It was commonly agreed that the Ohio River Canalization Project would be the test; that its improvement had more potential for success than any other in the nation; and if it did not succeed then federal improvement of waterways for navigation should, for the most part, be abandoned.

CHAPTER XI: LOUISVILLE DISTRICT AND CANALIZATION

The funds provided for construction of locks and dams in the Ohio River Canalization Project from 1910 to 1922 were expended chiefly on structures upriver from Louisville. Construction of only three navigation structures on the Lower Ohio — Lock and Dam No. 41 at Louisville; No. 43 at West Point, Kentucky; and No. 48 below Henderson, Kentucky, not far from the site of the wing dam constructed by Colonel Long in 1826 — was completed before 1922, and serious problems were encountered in their construction. Above the Falls of the Ohio most locks and dams were constructed on rock and compacted gravel foundations; below Louisville such stable foundations were seldom available. Shifting sand foundations, recurrent flooding of cofferdams, short working seasons, and other problems so delayed construction that abandoning the slackwater project below Lock and Dam No. 48 was considered.

Few contractors were hardy, or “foolhardy,” enough to undertake the projects below Louisville. But, through the leadership of such outstanding engineers as William H. McAlpine, construction methods to meet each exigency were devised by the Louisville District staff. In 1922 the big push to complete the canalization project to Cairo began on the Lower Ohio, and the Louisville District, which was also directing work on tributary streams and construction of a higher dam for both navigation and hydroelectric power production at the Falls of Ohio, became the “largest construction District” in the Corps. The slogan of the Ohio Valley Improvement Association was “On to Cairo by 1929,” and the Louisville District met this goal.

Canalization Administration

Engineer officers stationed at Louisville, as elsewhere, reported directly to the Chief of Engineers until 1888, when the Corps decentralized administrative functions by dividing its program in the United States into five sections supervised by five Division officers. The Louisville Engineer District was first placed in the Northwest Division. Division Engineers were ordinarily senior officers with long experience, who at the beginning functioned as both District and Division Engineer, and the sole staff of the Division office was commonly a single clerk.¹

The staff of Division offices gradually expanded, as Divisions were assigned project review, budgetary management, and comprehensive planning functions. On November 15, 1901, the Central Division, with offices at Cincinnati, was established to supervise Districts in the Ohio River Basin, then including Pittsburgh, Wheeling, First Cincinnati, Second Cincinnati, Louisville, Nashville, and Chattanooga Districts. After 1901 the Louisville Engineer District and other Districts became administrative entities with continuous records, no matter what staffing and project changes occurred, and all official reports and correspondence were channeled through the Central Division. The Central Division supervised operations in the Ohio Basin until the canalization project was completed in 1929. From 1929 to 1933 an effort was made to reduce administrative costs by consolidating several Division offices, but the system did not prove satisfactory. The Ohio River Division (ORD) was created on December 1, 1933, and it occupied the old Central Division offices in Cincinnati. ORD still

supervised Engineer operations in the Ohio River Basin in 1975.²

*Improvement of the Falls of the Ohio,
1897-1914*

From 1881 to 1901, 135,630 boats transporting cargoes aggregating 37,081,078 tons locked through the Louisville canal; the annual average was 6,780 boats and 1,854,053 tons. About 75 percent of this tonnage was coal; next in importance was lumber, followed by steel and iron products, sugar and molasses, salt, and agricultural produce. Traffic congestion was a major problem. On July 6, 1902, for instance, towboats pushing 461 barges arrived at the canal. By operating the canal full-speed around the clock, the canal staff completed 213 lockages to pass the coal fleet through by July 17.³

To enable coal-tow passage over the Falls and avoid the delays of lockage, rock excavation was undertaken at Indiana Chute at each low-water season prior to 1897, but this was an unsatisfactory process. A cofferdam was constructed in 1897 across the Indiana Chute to reveal the actual condition of the channel. The engineer in charge reported: "We have now an accurate knowledge of what has been done and what remains to be done, and in addition will be enabled to dispel the cloud of mystery which has for years made the Indiana Chute a terror to steamboat men." Sufficient excavation was accomplished to provide relatively safe navigation through Indiana Chute, and traffic continued to use the Chute at high water after Lock No. 41 was completed in 1921.⁴

The original timber-crib dam across the Falls, completed under the direction of General Weitzel in 1881, raised the pool above the Falls approximately three feet. A project to provide nine-foot navigation above the Falls to Madison, Indiana (the

site of proposed Lock and Dam No. 40), was completed about 1910. The completed dam along the crest of the Falls consisted of eleven sections of Boulé gates, Chanoine wickets, and masonry weirs. The District Engineer commented in 1914: "No other movable dam of as great width or contending against such adverse conditions is known to exist anywhere. The work was therefore more or less experimental and in view of the knowledge available at that time is very successful." The project had one major defect: the piers separating the dam sections, instead of being flush with the upstream edge of the dam, projected 42 feet upstream from the dam to serve as icebreakers. The maneuver boats operating the movable dam sections experienced difficulties in moving around the piers and on several occasions went over the dam and Falls and were lost.⁵

Lock and Dam No. 41: Construction

The Lockwood Board, when planning the Ohio River Canalization Project in 1906, proposed raising the dam across the Falls, widening the Louisville canal to 170 feet to permit traffic to pass while in the canal, and constructing a new lock, No. 41 of the Ohio River series, with dimensions of 85 by 600 feet. Major Lytle Brown, Louisville District Engineer, pointed out that the 85-foot wide lock would be the only one on the Ohio with less than the standard 110-foot width. He suggested that the Louisville lock be also 110-feet wide and the canal prism be widened to 200 feet, predicting that these changes would avert the "bottleneck" sure to develop when inland marine engineers designed floating equipment for the standard 110-foot wide Ohio River lock. The Secretary of war approved Major Brown's suggestions in 1911, and con-

struction of a standard Ohio River lock on the southwest side of the old double-lift Weitzel lock began in 1911.⁶

The Merrill rolling-gate had been used on locks on the Upper Ohio because of the engineering problems of constructing satisfactory mitring-gates for a 110-foot wide lock chamber. Rolling gates had several operational defects — the tracks and wheels required expensive maintenance and the gate recesses were badly silted up in high water. At Lock No. 37 just below Cincinnati, for instance, the lock recesses were filled with 2500 cubic yards of silt by the record flood of 1913. This was serious, for it required 28 days of round-the-clock work to get the lock back in operation. The problem of designing satisfactory 110-foot-wide mitring-gates was solved at Lock No. 41 by the Louisville District engineering staff — Principal Engineer William H. McAlpine, Assistant Engineers Paul Grunwell, Whitney I. Gregory, Frank I. Louckes, Robert A. Strecker, and Malcolm Elliott. Malcolm Elliott had charge of gate design, and the improved gates were chiefly the results of his work. Elliott later accepted a commission in the Corps of Engineers and became first District Engineer at Huntington, West Virginia, District in 1922.⁷

Construction of Lock No. 41 and enlargement of the Louisville canal were plagued by delays and accidents. The flood of 1913 filled the excavations with silt and debris, and recurrent floods substantially delayed progress. The lock contractor (Ohio River Contract Company) failed in 1915 and went into receivership; and during the first World War, 1917-1918, great difficulties were encountered in employing labor and purchasing materials. The old canal continued in service during enlargement, with a portion of the rock ledge and old stone-masonry wall

serving as a cofferdam between the old canal and the excavation. On October 5, 1915, a section of the old wall and rock ledge collapsed, releasing a wall of water into the new excavation. Work was then underway about 3,000 feet from the break, and locomotive and boat whistles gave warning. Before the water hit the work site, all workers, save one who drowned, managed to scramble out of the excavation. Floods, accidents, contractor failure, and limited funding delayed the opening of Lock No. 41 till May 1, 1921.⁸

Power Development at the Falls

While Lock No. 41 was under construction, interest in developing potential hydroelectric power at the Falls of the Ohio was increasing. To produce hydroelectric power economically it is necessary that adequate water and fall, or "head," be available a substantial percentage of the time. The movable dams of the canalization project seldom had sufficient "head" for commercial power production, but the Falls of the Ohio had been used to power water mills for many years and hydroelectric power production appeared feasible.

Perhaps George Rogers Clark was the first to recognize the water-power potential of the Falls; in 1807 he sold property on the Indiana side for the construction of a water-powered flour mill. The Tarascons of Shippingport erected a six-story flour mill powered by water wheels about 1815; the Army Ordnance Department considered constructing an armory at the Louisville Canal in 1823 to take advantage of available water power; water mills to crush limestone into Louisville hydraulic cement operated at the Falls until 1892; and the Ohio Falls Hydraulic and Manufacturing Company operated a large flour mill near Jeffersonville until 1902. When their flour mill burned in 1902, the Ohio

Falls Company developed plans for a million-dollar dam across the Falls to maintain a pool level of 12.7 feet at low water and facilitate power production.⁹

Major George McC. Derby, Louisville District Engineer, strongly supported the company's plans in 1903, pointing out that such a dam would provide a long slack-water pool for navigation and that improvements in electric power transmission made such a project feasible. He predicted:

The construction of a dam at Louisville that will make this water power available for commercial purposes is a probability of the near future that should be reckoned with in connection with the improvement of navigation, the more so as the two interests need not necessarily conflict with each other, but, on the contrary, might readily be so adjusted as to be mutually advantageous.¹⁰

But the company never matured its plans and the subject was dropped until 1912, when District Engineer Lytle Brown (Chief of Engineers, U. S. Army, 1929-1933) and his chief assistant, William H. McAlpine, restudied the project. Major Brown published several articles in engineering journals which clearly demonstrated that improved low-head hydroelectric turbines and the growing industrial market at Louisville made the development of power at the Falls of the Ohio practicable. The Army Ordnance Department studied the Falls in 1917 as a possible location for nitrate plants for munition production, but eventually selected sites near Muscle Shoals on the Tennessee River.¹¹

District Engineer George M. Hoffman reviewed the power situation at the Falls in 1920. He found that a coal-shortage, chiefly caused by traffic congestion on railways during and after the war, had multiplied the price of coal and the power produced at steam-electric plants. Louis-

ville also suffered annual losses of three million dollars as a result of coal-smoke air pollution. Colonel Hoffman believed that these problems could be alleviated and Ohio River navigation could be benefited by the construction of a higher, combined power and navigation dam at the Falls, which reduced the costs of the canalization project by eliminating the necessity for constructing proposed Dam No. 40 at Madison, Indiana.¹²

The existing dam at the Falls in 1920 was designed to maintain an upper pool elevation at 412 feet, providing a minimum depth for navigation upriver to the proposed site of Dam No. 40. In 1921 the Louisville District initiated planning to raise Dam No. 41 to furnish a stable pool eight feet deeper; that is, to raise the upper pool to elevation 420, thereby eliminating Dam No. 40. The District also publicized the fact that the higher pool elevation would provide sufficient "head" for economic production of secondary hydroelectric power.¹³

After Major Lytle Brown had published his study of the power potential at the Falls in 1912, John William Link, Hydraulic Engineer for Byllesby Engineering and Management Corporation, of which Louisville Gas and Electric Company was a subsidiary, had begun studies of the project. Byllesby Engineering organized the Louisville Hydro-Electric Company and in 1923 applied to the Federal Power Commission (FPC) for a license for a power project connected to Dam No. 41. Municipal authorities of Louisville also became interested in the project, employed Major General William L. Sibert to make the engineering studies, and applied for a license.¹⁴

General "Goliath" Sibert had left the Ohio Valley in 1907 to join General George W. Goethals (who, like Sibert, had

acquired his first civil works experience in the Ohio Valley as assistant to Colonel Merrill) in completing the Panama Canal. General Sibert had served as first Chief of Chemical Warfare Service during the First World War and returned to the Green River Valley in 1920, settling at Bowling Green to pursue his fox-hunting hobby and a career as consulting engineer during retirement.¹⁵

Because Louisville would have had to build its own power distribution lines, or take over the Louisville Gas and Electric Company through condemnation proceedings, and in either case would have exceeded its bonding limitations, the FPC awarded the license for power development at the Falls to Byllesby Engineering on December 4, 1923. Construction of a new dam and powerhouse on the Falls began in 1925 and was completed in late 1927. New Dam No. 41 was an "L" shaped structure, eight feet higher than the old dam and 8,652.6 feet long, consisting of 3,832 feet of fixed dam, 3,740.6 feet of movable Boulé dam, 220 feet of bear-traps and bear-trap piers, and 860 feet of Chanoine wicket navigable pass. The concrete powerhouse had eight turbine power units, with 108,000 horse-power capacity. After testing, power production began on October 10, 1927, and the low-head turbines performed well. In fiscal year 1931, for instance, power production was suspended because of lack of "head" for only nine days and total production amounted 257,467,300 kilowatt hours.¹⁶

Nadir of Ohio River Commerce

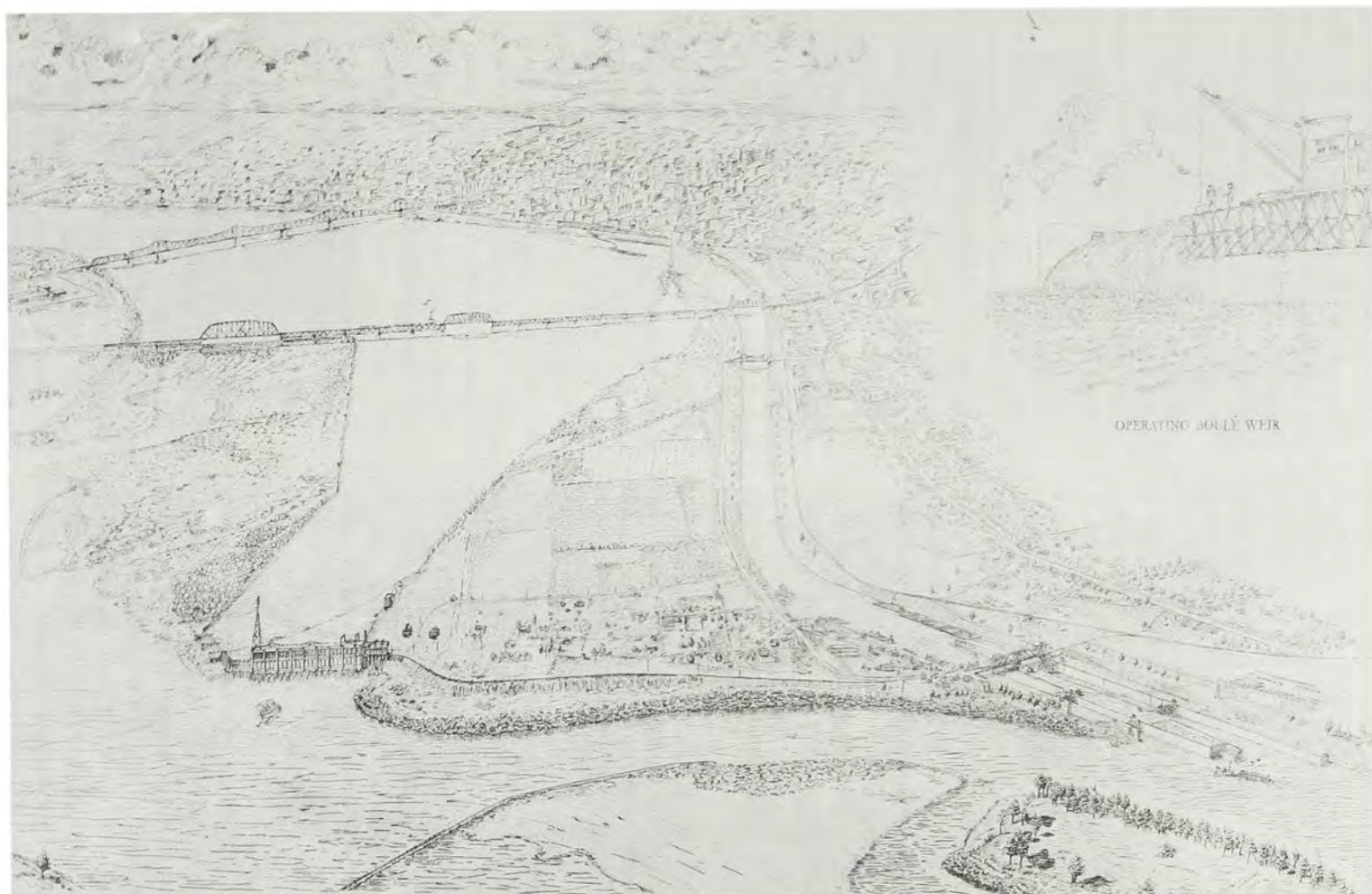
By 1917 the waterborne commerce which the Ohio River Canalization Project was designed to serve had practically come to a halt. The steamboat packet and freighting business dwindled throughout the first quarter of the twentieth century,

and in 1916 the historic shipment of coal from Pittsburgh to New Orleans abruptly ceased. Waterborne commerce on the Ohio reached a low in 1917 of 4,598,875 tons. Colonel Thomas P. Roberts, who had participated in the survey of the Ohio River just after the Civil War and who had become an Assistant Engineer in the Corps, said in 1923: "At present the Ohio is, to a considerable extent, only a playground for owners of small locally owned boats engaged in a short-distance transportation."¹⁷

The transportation needs once served by the steamboat packets ceased to exist in the twentieth century, but a few packets continued to eke out a business until the Depression of the 1930s. The end to the Pittsburgh to New Orleans coal trade was more sudden. The Monongahela River Consolidated Coal and Coke Company, or the "Combine," including nearly every coal shipper in the Pittsburgh area, had been formed in 1899, and by 1906 it owned and operated 80 towboats and 4,000 barges and coalboats, moving about 1.2 million tons of coal annually to New Orleans. But the need for coal of the steel industry of the Upper Ohio Valley, competition from Alabama coalfields and Oklahoma oil in the New Orleans market, and major losses of floating plant on the unimproved Lower Ohio and Mississippi rivers led the Combine management to the decision to end the coal trade on the Ohio in 1916. Thus, in one stroke, fifty percent of the total waterborne commerce on the Ohio was taken from the river.¹⁸

Colonel William W. Harts, Central Division Engineer, said in 1923:

The supreme test of the public value of any inland waterway must always be an economic one. Can the actual ton-mile cost to the shipper of hauling by barge and towboat, or by other similar means, when added to the ton-mile cost of interest



Drawing showing the combined navigation and hydro-electric development at the Falls of the Ohio at Louisville, Kentucky.

on the first cost, depreciation, and maintenance of the water-way now borne by public taxation, effect, when combined a savings over other means of transportation?¹⁹

Estimates of the ton-mile costs on the Ohio River, after the end of the long-haul coal trade, were not favorable, for the overhead costs on the canalization project were relatively fixed and diminishing traffic resulted in a relative increase in costs per ton-mile. Costs of the canalization project were calculated in 1922 at 13.4 mills per ton-mile. Adding the 5 mills per ton-mile charge of the carriers led to the conclusion that freight moved on the Ohio at 18.4 mills per ton-mile. When compared to prevailing railroad rates of 13.9 mills per ton-mile, the Ohio River Canalization Project appeared to be a poor investment.²⁰

Frank A. Alfred, a railroad official, asserted:

It does not seem likely . . . that the completion of the improvement project will result in a considerable increase of river traffic. Coal which formerly went from Pittsburgh to New Orleans is now obtained from Tennessee and Alabama, partly by rail and partly by water. The sand and gravel business is purely local and would have existed in about its present volume if no improvements had been made. In the light of present experience, one is forced to the conclusion that the construction of these works was an economic waste. The Ohio is the one river in the United States on which there seemed to be a fair prospect of developing a large and important traffic. These great expectations have not been realized and the writer feels it must be admitted that the experiment is a failure.²¹

The Corps still predicted that, in the end, the project would be successful. Major Malcolm Elliott, former Assistant Engineer in the Louisville District, compared the Ohio River Canalization Project to a railroad under construction from Pittsburgh to Chicago which was completed only to Fort Wayne. It could not be

a paying proposition until completed. And William M. Hall, Assistant Engineer on the canalization project, questioned the necessity for computing the economics of the project:

The Government is now spending money many times as much for highways and National paved roads as for rivers and harbors. No such test as that referred to seems to have been suggested as a condition for that expenditure. Why, then, should such a test apply and be the final criterion for river improvement any more than for public highways for automobiles, horse, and pedestrians from which no revenue is received or expected except in the way of National prosperity and the tax thereon?²²

In this atmosphere of doubt of the project's efficacy and predictions of dire failure, Congress expressed its faith in the capability of the Corps and its belief that waterways transportation had a future in the United States by making substantial appropriations for rivers and harbors in 1922 and in subsequent years. To avoid falling again into the "pork barrel" pit, it assigned the total appropriations to the War Department for allotment to projects according to their merits, and the Ohio River Canalization Project was given large shares to expedite its completion. The slogan popularized by the Ohio Valley Improvement Association was: "On to Cairo by 1929!"²³

Largest Construction District of the Corps

The First Cincinnati Engineer District continued to administer the old open-channel project on the Ohio until 1929. Construction of the locks and dams was assigned to Pittsburgh District, from the head of the river to Steubenville, Ohio (Locks and Dams. Nos. 1-10); Wheeling District, from Steubenville to Huntington, West Virginia (Nos. 11-28); Second Cin-

cinnati District, from Huntington to Madison, Indiana (Nos. 29-40); and Louisville District, from Madison to the mouth of the river (Nos. 40-54). Prior to World War I, the District Engineers participated in the Ohio River Board centered at the Wheeling office, which worked out standard designs for the locks and dams and studied related problems, but after the war most construction was in the Louisville District and the Ohio River Board suspended its meetings.²⁴

In 1922, as active construction ended on the Upper Ohio, the Wheeling and Second Cincinnati Districts were consolidated in an Engineer District at Huntington, West Virginia, and the First Cincinnati District was assigned a section of the canalization project. The Louisville Engineer District, after 1922, was constructing and operating twelve locks and dams on the Ohio in addition to its projects on tributary streams and the new dam at the Falls of the Ohio. A. G. Wakefield, Chief Clerk of Louisville District, 1924-1945, claimed that during the 1920s the Louisville District was the "largest construction district in the United States." It is a fact that Nicholas Longworth, Majority Leader of the House of Representatives, heard a rumor in 1925 that Louisville and Cincinnati Districts were to be consolidated and asked the Chief of Engineers if it were true. The Chief replied that the Louisville District had such a workload, that if any change at all were made it would be to subdivide it into several Districts.²⁵

Construction of Locks and Dams Nos. 43 and 48

Locks and Dams Nos. 41, 43, and 48 were first selected for construction in the Louisville District. The Ohio River Contract Company was awarded the contract for Nos. 41 (at Louisville canal) and 48

(near Henderson, Kentucky) in 1911. The firm failed in 1915 and the projects were completed by subcontracts let by the receiver. The Louisville District recommended in 1913 increasing lock-lifts and relocating proposed dam-sites to eliminate a lock and dam between Nos. 41 and 48 to reduce costs, and, after study, proposed Lock and Dam No. 42 was deleted from the project.²⁶

All locks and dams constructed above Louisville rested on rock or compacted gravel formations; below Louisville almost every lock and dam would have to be constructed on unstable sand and gravel. Potential contractors refused to bid on the lower river projects, saying it would be "impossible" to construct impervious cofferdams on such a foundation. As a result, most locks and dams on the Lower Ohio were completed by the District staff with hired labor.²⁷

And the troubles experienced in constructing Locks and Dams Nos. 43 and 48 were not encouraging. Ohio River Contract Company, the sole bidder, was awarded the contract for No. 48 in 1912. The project was flooded and heavily damaged by the near-record flood of early 1913. Then on July 21, 1913, a cofferdam "blew out." Four loaded coal barges, a barge of lumber and a barge of piles were drawn through the break and rolled over and over, destroying much of the contractor's equipment. There were no bidders for construction of No. 43, and the District undertook the work with hired labor. Records of work at the project in late 1914 and early 1915 indicate some of the problems experienced: on October 16 cofferdams were flooded; they were pumped out and work resumed October 21. They were flooded again December 9, pumped out on December 17, and flooded again on December 22. Work resumed

April 28, 1915; the cofferdam was flooded on May 27; pumped out on June 18; flooded on June 19; pumped out again June 24.²⁸

In 1918 the worst ice conditions of record on the Ohio River hit the projects. James F. Nutty, Chief Clerk, telegraphed the President of the Mississippi River Commission and requested aid in retrieving the floating equipment descending the Ohio in the ice gorge. It included all the contractor's floating plant from Dam No. 48, most of the government floating plant from Dam No. 43, plus fifty coal barges, a towboat, and hundreds of miscellaneous watercraft. Most of the government vessels were eventually retrieved, but the contractor at No. 48 lost equipment valued at \$50,000. As a result of floods, ice gorges, cofferdam problems, and other delays, No. 48 took eight years, 1913-1920, to complete, exceeding the original contract time limit 100 percent. No. 43 took seven years, 1914-1920.²⁹

These difficulties created doubt about the future of the project and study began in 1918 of eliminating all locks and dams of the series below No. 48 and maintaining the channel by dredging. The Louisville District found that a nine-foot depth could not be maintained economically by open-channel work. To lower project costs, it designed Chanoine wickets twenty-feet long for the lower river and relocated the dam-sites to eliminate one lock and dam, renumbering the structures to delete number 54 of the series.³⁰

Construction Methods

Construction on the Ohio was, and is, subject to many difficulties not encountered on dry-land projects. Floods frequently arrived unexpectedly, topping cofferdams, injuring equipment, destroying completed work, and burying the work

under tons of silt. Work was ordinarily suspended during bad weather and high water seasons; on this account, contractors were often allowed a certain number of "fair working days" to complete a project. Delays and accidents beyond the control of the contractor were usually considered ample reason for extending contract time, but contractors assumed all risk to the equipment and unfinished construction. And this was why few contractors were interested in bidding on the locks and dams below Louisville.

Since most project sites on the lower river were distant from large towns, the first step, after land acquisition was complete, was to construct quarters for hired labor — usually consisting of an office, a warehouse, a machine and blacksmith shop, a cement shed, a mess hall, bunk houses, family quarters, and a small power house. At Dam 50 (near Cave-in-Rock) quarters for 300 workers were constructed; at Dam 46, near Owensboro, no quarters were required. On the Upper Ohio the cost of a lock and dam had been estimated at \$1,200,000 where the river was 1200 feet wide, adding \$400 for each additional foot of width, and actual costs approximated these estimates. On the Lower Ohio, the isolated locations of most structures and the shorter working seasons because of high water increased costs. The rule-of-thumb used by Principal Engineer William H. McAlpine for each lock and dam was \$500,000 for preliminary work; \$1,200,000 to \$1,400,000 for lock construction; \$700 per linear foot of dam; and about \$150,000 for contingencies.³¹

William H. McAlpine, the Principal Assistant Engineer of Louisville District, 1912-1930, supervised most construction on the Lower Ohio. Mr. "Mac" as he was known to his colleagues, was an 1896 graduate of Massachusetts Institute of

Technology. He began his service with the Corps on the Kentucky River in the Cincinnati District in 1902. Mr. Mac directed design and construction of locks and dams on the Upper Mississippi River from 1930 to 1934, then became Chief of Engineering Division, OCE, serving as consultant on scores of flood control, hydroelectric, navigation, and multipurpose projects. In 1946, Mr. Mac was recognized as "foremost in his field," and by permission of Congress was appointed Special Assistant to the Chief of Engineers, senior to all other engineers in the Corps.³²

When the Louisville District Engineer learned that Mr. Mac had been offered a lucrative position with a private firm in 1916, he urgently recommended an increase in salary, declaring that Mr. Mac's services would save the United States a hundred thousand dollars on each lock and dam completed on the Lower Ohio. Mr. Mac stayed with the Corps and completed some fifty-four years of service to the nation before his death in 1956.³³

One of the engineering problems Mr. Mac and the District staff solved on the Lower Ohio was building locks and dams on a sandy foundation. The solution chiefly consisted of driving round timber piles, ordinarily about thirty feet long, to the rock substrata, and building the concrete foundation for the lock or dam structure around the tops of the piles. Wooden and, later, interlocking-steel sheet piling was driven down on the upstream side of the structure to form a curtain protecting the foundation. Riprap stone was placed on the downstream side to prevent scour and further stabilize the structure. Only one foundation failure was experienced during construction of the canalization project, and that was at Dam No. 26 on the upper river where a weak shale foundation slid laterally.³⁴

Cofferdams, usually in three sections to hold out the river while the site was excavated, piles driven, concrete poured, and movable wickets installed, also presented a problem. The first cofferdams used on the canalization project were the "Ohio River box type" — wooden box frames about twenty feet wide and sixteen to twenty feet high, which were dropped into the river in sections side by side and filled with sand by dredges. No effort was made to keep them completely watertight, and powerful pumps served to keep the working area within the coffer reasonably dry. Steel cofferdams, of interlocking-steel piling filled with dredged materials, were first used by the Corps in raising the battleship *Maine* from Havana harbor, and they came into use on the Ohio about 1917. They were not used extensively on the Lower Ohio, however, because Mr. Mac did not think their advantages outweighed the difficulty and expense of removing the piling after work was completed.³⁵

Sand and gravel aggregate for concrete was dredged from the riverbed. Some mixing plants were placed on and in the cofferdams, and the concrete was distributed to the forms in buckets on small flat cars hauled by tiny locomotives, or by cables attached to a stationary engine. Floating mixers were used on occasion, and at Dams Nos. 45 and 46 Assistant Engineer H. G. McCormick used a plan for placing concrete through chutes from a movable concrete mixer mounted on rails.³⁶

One particularly interesting development was the application of "Taylorism," or efficiency engineering, to the Ohio River project in 1915. Uniform cost-keeping accounting had previously been applied to shop and office management; Lieutenant Stuart C. Godfrey, mathematics professor at West Point, was assigned



MISTER "MAC"—William H. McAlpine

to various construction sites on the Ohio in the summers of 1912-1917 to apply cost-keeping and efficiency management to field engineering. At such projects as Dams Nos. 39 and 43, the new accounting system made it possible to make available to project engineers the precise costs of a day's work by 9:00 a. m. the following morning. Reaction to the system was mixed, however. Captain Henry A. Finch, project engineer at Dam No. 39, believed the savings derived from the cost-keeping efficiency system were less than the cost of the system itself, and asserted that common sense combined with close personal observation by the engineers in the field was more economical and equally as effective as the new system.³⁷

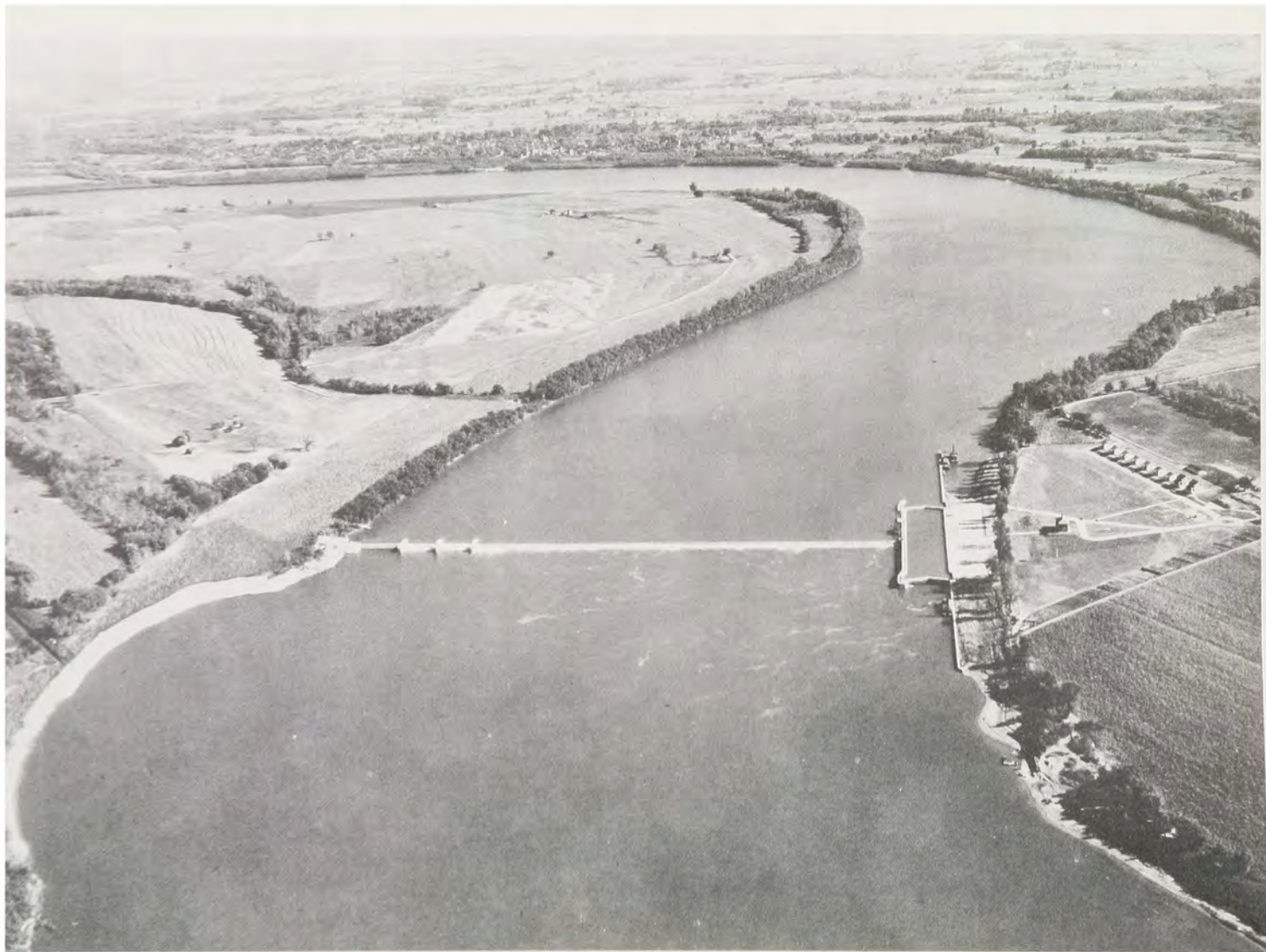
The experimental work of Lieutenant Godfrey foreshadowed, however, a type of engineering which was to be applied to civil works by the Corps nationally. Lieutenant Godfrey also applied the system to combat engineering; he received a commendation from General John J. Pershing during the First World War for constructing a 1,440-foot pontoon bridge in 58 minutes, 30 seconds. Godfrey later served as Chief of Finance Division, OCE, and in 1941 became Engineer of General Headquarters, U.S. Army Air Force, in which capacity he organized and led the first airborne aviation engineers.³⁸

The problems with operation of the Merrill rolling-gates have been previously discussed. The vertically framed mitering-gate constructed of structural steel and operated by a hydraulic oil cylinder and piston, designed in the Louisville District in 1913, became standard on the Ohio River. They opened and closed more swiftly with a single stroke of the piston, required less than half the power to operate, and eliminated the troublesome gate recesses. The Chanoine wickets used at

Davis Island, but increased in length to twenty feet, remained standard for the navigable pass in the lower river; however, the navigable pass at Davis Island (No. 1) was 559 feet wide, as compared with 1,248 feet at Dam No. 53. The bear-trap weir, installed at Davis Island in 1891, was standardized on the lower river at two weirs, each 91 feet long, between masonry piers. The lower leaf was made entirely of steel and the upper leaf was a steel frame with wooden filler. The remaining weir capacity was either Chanoine wicket or movable Bebout wickets (designed by Assistant Engineer Guy B. Bebout of Wheeling Engineer District).³⁹

To meet the goal of completing the project to Cairo by 1929, the work in the Louisville District was carried on with some urgency from 1927 to 1929. Construction of the last structure of the series, Lock and Dam No. 53 below the Grand Chain, began with the construction of a camp for workers in 1924. No. 53 included the standard Ohio River lock, a 1,248-foot wide Chanoine navigable pass, two standard bear-trap weirs, and Chanoine and Bebout weir sections, the latter maneuvered from a trestle. The construction of No. 53 was pressed forward 24 hours a day, seven days a week when water stages permitted. The largest inland suction dredge in the world, the *C. B. Harris*, with a thousand-yards per hour capacity, was brought in to make the excavations and fills.⁴⁰

All workers were facing the inevitable reduction in force when the project was completed, but to finish the project in 1929 it was necessary to keep morale at a high pitch and relatively high wages were paid. But hard work was expected in return. One worker later recalled: "They drove us like mules. Didn't matter how



Lock and Dam 49 on the Ohio River. This was typical of the original low-lift structures built as part of the Canalization of the Ohio.

hard it rained. We worked. Nor how cold it got. We worked." Major W. W. Gruber, an Assistant Engineer on the canalization project, wrote a poem in 1929 about his experiences, which read, in part:

Now the Chief wants both gates finished
 An' the coffers torren out,
 An' the jacks and sectors 'spended
 So's to concrete round about;
 The pipe lines must be coupled
 An' the valves put in their place,
 The turbine swung into its pit
 An' set to run its pace,
 An' he wants them rocks unloaded,
 Them as weighs ten ton or more
 An' he told us to dig gravel
 So's that concrete we can pour;
 Now we can't do much with nothin'
 'Til its fixed so's it won't sink,
 But the derrick boats is busted
 An' the highline's on the blink.

Then you're pluggin' like the devil
 Day an' Sunday an' at night,
 An' you do your level damndest
 Just to get things goin' right;
 Then the Big Chief comes a lookin'
 Just to find all fault he can,
 Sees a derrick boat is idle,
 Says this crew ain't worth a damn,
 He could do the job much better
 An' with half the time and men,
 If he only wasn't busy
 In the office now and then.
 Well I'd like to see him do it
 With this worn out Army junk,
 When the derrick boats is busted
 An' the highline's workin' punk.⁴¹

Completion Ceremonies, 1929

Lock and dam No. 53 was completed on August 27, 1929, and the Ohio Valley Improvement Association joined with other river interests in organizing a project Dedication Cruise from Pittsburgh to Cairo in October, 1929, signaling the completion of the Ohio River Canalization Project at costs of about \$125,000,000. A flotilla of packets departed Pittsburgh on October 18. Pilots of the flagship, the *Cincinnati*,

were Captain James H. Rowley (nephew of George Rowley) who had participated in the Davis Island Dedication ceremonies in 1885, and Captain Jesse P. Hughes, who had piloted a boat at the dedication of the second lock and dam, No. 6, completed in 1904. Among the crowds of congressmen, Corps officials, and representatives of commercial interests, were James Milnor Roberts, grandson of William Milnor Roberts, and Major General "Goliath" Sibert. Crowds gathered at riverside to wave at the passing packets, and sirens, bells, whistles, cannon salutes, and brass bands greeted the fleet at every stop.⁴²

President Herbert Hoover, a professional engineer, joined the cruise at Cincinnati on October 22. He unveiled a commemorative monument at Cincinnati, and in his address to the crowd expressed his regret that Colonel William E. Merrill and others who had initiated the project had not lived to see its completion. The President boarded the *Greenbrier* for the trip to Louisville, and as the boats passed Madison, Indiana, there was a grim reminder of the Davis Island celebration of 1885. A soldier was killed by a premature explosion of powder while firing a salute. President Hoover landed at Louisville on October 23, addressed a crowd at Louisville Auditorium, and his speech showed a remarkable sensitivity to the historic aspects of the occasion:

While I am proud to be the President who witnesses the apparent completion of its improvement, I have the belief that some day new inventions and new pressures of population will require its further development. In some generations to come, they will perhaps look back at our triumph in building a channel nine feet in depth in the same way that we look at the triumph of our forefathers when, having cleared snags and bars, they announced that a boat drawing two feet of water could pass safely from Pittsburgh to New

Orleans. Yet for their times and means they, too, accomplished a great task. It is the river that is permanent; it is one of God's gifts to man, and with each succeeding generation we will advance in our appreciation and our use of it. And with each generation it will grow in the history and tradition of our Nation.⁴³

The President left the cruise at Louisville, and the cavalcade continued on to Cairo. At Lock and Dam No. 53, General "Goliath" Sibert, who had so much to do with the adoption of the nine-foot project in 1910, addressed the crowd, and then a satin ribbon stretched across the lock was cut and the fleet locked through. It reached Cairo and landed on October 29, 1929, and after sunset the *Cincinnati* departed on the return trip to the sound of a band playing "'Till We Meet Again." The band should have played "Taps," for October 29, 1929, was the day of the resounding crash on Wall Street, which, in addition to many other effects, brought a rapid end, except for historic relics, to the steamboat packet business.⁴⁴

Conclusion

Both friends and foes of the Ohio River Canalization Project had looked forward to the completion of the project in the belief that its operation would provide conclusive support for their respective views. The editor of *Engineering News-record* commented in early 1930 that only a great increase in traffic on the Ohio would justify the public investment, and that all future investments in waterways projects should depend, very largely, on the success or failure of the project.⁴⁵

The canalization project had cost only about a third as much as the Panama Canal, but had taken twice as long to complete. Senator James E. Watson of Indiana, member of Congress, 1895-1933, had these thoughts on the reasons for the

slower progress on the Ohio:

The Ohio River . . . always has been counted a necessary project, and . . . numerous appropriations were made for this lock or that dam, until, covering a long series of years, a work that should be consummated in a decade, has at last been finished. When a River and Harbor bill came before Congress in the old days we had to appropriate for enough rivers to get enough legislators to carry it through, for if we didn't and the outsiders would outnumber the insiders, they would start to amend the bill, and it would be amended until we would run counter to the President's wishes and meet with executive inter-position. We had to appropriate money enough to get enough people interested to pass the bill, and no matter how meritorious a proposition might be, if we didn't have votes enough, it was lost. I have voted to appropriate money to improve rivers that should have been macadamized for highways. . . I hope that day has passed in the American Congress

. . .⁴⁶

Completion of the nine-foot project came far too late to aid the steamboat packet and freighting business, and, somewhat ironically, the barge-towing interests who had opposed the project at its inception were the chief recipients of the benefits of the project. Though the long-haul coal trade to New Orleans had ended in 1916, a short-haul trade continued and, as steam-electric plants were constructed at riverside, began to grow. Construction of steel-hull barges and boats, for use chiefly on the Monongahela, began about 1910 in the Ohio Valley. In October, 1921, Jones & Laughlin Steel Corporation of Pittsburgh loaded 4,000 tons of steel products in steel barges, moved them down the Ohio and Mississippi, and saved a tidy sum thereby. The company began regular shipments, and was soon emulated by Carnegie Steel, American Bridge, Inland Steel, Wheeling Steel and other corporations. This new traffic and the support of the corporations for rapid completion of the canalization project was doubtless a great aid to the proponents of the project

in Congress.⁴⁷

The shipment of petroleum products in steel tank barges also reached a significant proportion in the 1920s; the amount shipped down the Ohio to markets in the Mississippi Valley reached 100,000 tons in 1925. Private carriers, owned by steel, petroleum, and other corporations, transported 95 percent of the commerce on the Ohio in 1926, but as the canalization project neared completion the American Barge Line of Louisville, a common carrier, began operations with 50 steel barges and three Diesel towboats.⁴⁸

The first returns on the public investment in the canalization project did not appear promising — tonnage fell to a Depression low of 14 million tons in 1932. But by 1939 tonnage was roughly 26 million tons; ton-mileage, indicating move-

ment of cargo longer distances, was double that of 1929; and steel and petroleum, neither of which moved via the Ohio to any appreciable extent prior to 1929, ranked second and third behind coal in tonnage. The Lockwood Board had predicted in 1906 that a nine-foot project on the Ohio would produce transportation savings of \$2,280,000 annually; estimated savings by 1939 were several times that figure.⁴⁹

Perhaps more important to the average citizen of the Ohio Valley was the fact that transportation savings enabled producers to make a greater profit which was passed on by the producers to the consumers to the disadvantage of competitors, but to the benefit of the public whose taxes had funded construction of the Ohio River Canalization Project.

CHAPTER XII: ORIGINS OF OHIO VALLEY FLOOD CONTROL

Floods occurred in the Ohio Valley long before European explorers entered the region and before American pioneers denuded the region of its virgin forests. Fragmentary records indicated the flood of 1763 was the highest of record on the Upper Ohio River until 1936, and the flood of 1773 reached a height on the Lower Ohio probably not exceeded until 1937. These floods, because of the sparse population of the Ohio Valley, caused little property damage and human distress, but as settlements developed in the flood plain the consequences of each flood increased proportionately. The great floods of 1832, 1867, 1883, and 1884 on the Lower Ohio caused major damages, and after the flood of 1884 the Corps of Engineers was assigned its first limited flood control mission in the Ohio Valley.

Damages to the human environment resulting from floods in the twentieth century were so staggering that great public support developed for a comprehensive program of flood control. Planning studies were made from time to time by the Corps in the early part of the century, and in the 1920s the comprehensive "308 Reports" were commenced. After the calamitous Ohio River floods of 1936 and 1937, Congress committed the United States to a complete program of flood control and authorized construction of elements of the Ohio River Flood Control Plan. The Louisville Engineer District, as part of a nationwide Corps effort, launched construction in 1937 of the first elements of the program to provide substantial protection against flood disasters for citizens and industry in the Lower Ohio Basin.

Early Flood History

Thomas Hutchins, British Army Engineer, was stationed at Fort Pitt when floods occurred in 1762 and 1763. Hutchins and the British at Fort Pitt provided flood relief for victims — mostly Indians — of the flood of 1762, and during the flood of 1763 he and other British Army Engineers directed evacuation of the fortifications at Pittsburgh and completed doubtless the first flood-damage report in the Ohio River Basin — two lives were lost and a number of cabins destroyed.¹

On the basis of historical records, it has been estimated that the 1773 flood on the Lower Ohio was as great as that of 1937; it crested at only 75 feet at the site of Cincinnati, while the flood of 1937 approached 80 feet, but it occurred before man-made structures encroached on the flood plain. It is also known that a major flood occurred in the Wabash Valley in the spring of 1779, because, it will be recalled, General George Rogers Clark had to contend with the flood in his historic march across Illinois to assault the British forces at Vincennes. But the heights of the earliest floods in the Lower Ohio Valley are matters of conjecture, and because of limited population and urban development at the time did not constitute major calamities. The first record of serious flood damages at Louisville was printed in the *Louisville Correspondent* on April 3, 1815:

The extraordinary swell in the Ohio during the last week must have occasioned incalculable loss to persons owning property adjacent to the river. We understand that the valuable manufacturing

mill owned by Mr. Tarascon of Shippingport has been swept off, and a number of other mills in the vicinity of this place have been considerably damaged. It is said to be higher at this time than it has been known for the last twenty years.²

Flood of 1832

The flood of February, 1832, set records throughout the length of the Ohio River. It crested at 62.5 feet at Cincinnati; 44.5 feet at Louisville; and 63.6 feet below the Falls at New Albany — records which stood for fifty years. An eye-witness to the disaster at Cincinnati declared:

It was painful to witness destruction on so vast a scale — some houses upset, others in imminent danger . . . Flatboats loaded with women and children, furniture, and live-stock, were busily engaged in Race, Vine, Elm, and Walnut streets.³

The fire-house at Marietta, Ohio, complete with fire engine and buckets, was swept down river and found at Louisville six days later. Flood damages were severe from Pittsburgh to New Orleans. A Louisville newspaper reported that only the church steeple at Lawrenceburg, Indiana, remained above water and that "millions can scarcely compensate for the damage that has been experienced."⁴

First Corps Studies of Ohio River Floods

When the flood of 1867 hit the extreme lower section of the Ohio River, W. Milnor Roberts, Superintendent of Ohio River Improvement for the Corps, was directed by the Chief of Engineers to study the flood and report on its effects. During these studies, Roberts computed the effects which the reservoir system proposed by Charles Ellet in 1850 might have had on its crest, and concluded that control of floods by reservoirs "by any human means attainable within the practicable limits of cost is impossible."⁵

In planning the Ohio River Canalization

Project in the 1870s, Colonel William E. Merrill also reviewed the navigation-flood control system proposed by Ellet, and he also concluded the system had problems too complex for solution at that time. Land acquisition costs would be enormous; "terrible disasters" might result from improper reservoir management; and the engineering problems of constructing such reservoirs were, in the opinion of Colonel Merrill, beyond solution. He said:

To build a dam 50 feet high in a running stream is excessively difficult. Reservoirs even built perfectly dry . . . sometimes burst, and even when you select your ground for the very purpose it is difficult to prevent water under such a heavy pressure of 50 feet . . . getting around the sides even if not going through the dam.⁶

Ohio River Floods of 1883 and 1884

The Ohio Valley suffered a flood in February, 1883, which surpassed the 1832 record at Cincinnati by over two feet and crested at Louisville about three feet above the previous record (44.8 on the upper gage at the Falls and 70.2 on the lower gage on February 16). Colonel Merrill reported a cofferdam at Davis Island Dam project was carried away and the flood breached the canal wall at the head of Louisville locks, but he supposed, like everyone else, that the flood of 1883 was the climax for at least one generation. But precisely a year later a greater flood ravaged the Valley.⁷

On Valentine's Day, 1884, the Ohio crested at Cincinnati at 71.1 feet, about four feet above the crest of 1883; on February 16 it reached 47.7 on the upper gage and 72 feet on the lower gage at Louisville. Flood damages were so catastrophic that Congress appropriated funds for the relief of flood victims (probably the first federal flood disaster relief provided for the Ohio Valley) and authorized the first

federal flood control projects in the Ohio Basin.⁸

First Ohio Valley Flood Control Projects

In 1884 *Engineering News* published an article asserting that, "in view of appalling and annual loss of life and property in the Ohio Valley from floods," Colonel Merrill and Corps of Engineers ought to be authorized to survey Ohio river tributaries for suitable flood control reservoir sites. The article concluded: "Against the flooding of cheap lands on the tributaries, look at the millions of property destroyed in the cities and towns below." Congress was not prepared to authorize such a study; however, it did order investigations of levee projects at Jeffersonville and Lawrenceburg, Indiana, and Shawneetown, Illinois.⁹

About 80% of the inhabitants of Jeffersonville had been forced to evacuate during the flood of 1884, and the transportation of military supplies from Jeffersonville Quartermaster Depot had been suspended for some time. Congress directed, on March 1, 1884, the Corps to report "as to the practicability and probable cost of constructing a levee to prevent the overflow of said city of Jeffersonville and the approaches to the quartermaster's depot." Colonel Merrill reported that a levee to protect the town and depot to a height two feet above the high water of 1884 would cost \$50,000, and Congress provided that amount, the first federal appropriation for flood control in the Ohio Valley, in the Rivers and Harbors Act of July 5, 1884, for the "improvement of the navigation of the river at Jeffersonville, and the protection of the Government property." Flood control was not specifically mentioned in the act; Congress actually authorized not flood control, but the protection of the quartermaster depot and the improvement of

navigation. Presumably, a levee would keep boats out of Jeffersonville during time of flood and provide a wharf for loading military supply shipments. Perhaps needless to say, "Padre" Merrill did not approve of the policy of providing for flood control under the guise of improving navigation; nevertheless, he performed his duty as directed.¹⁰

The contract for construction of the levee was awarded to Joseph Coyne of Jeffersonville on April 30, 1885, and the work was completed in August, 1886. The levee was 5,818 feet long, contained about 44,000 cubic yards of earth, and was built to two feet above the crest of the record flood of 1884.¹¹

Lawrenceburg, Indiana, and Shawneetown, Illinois, had suffered repeated flood damages, and municipal authorities, with aid from railroads with lines along the waterfront, had expended substantial sums constructing levees, but they were overtopped by the floods of 1883 and 1884. Colonel Merrill, at the direction of Congress, reported in 1884 that, though levee construction would not benefit navigation, both towns needed flood protection. Congress was not prepared to adopt a definite policy for flood control; nevertheless, Lawrenceburg and Shawneetown obtained appropriations for raising and strengthening their levee systems.¹²

Congress funded embankment construction at Lawrenceburg in 1886 to confine the Miami River during floods and prevent the formation of bars which might obstruct navigation; and Shawneetown received an appropriation in 1888 to raise its levees to "confine the waters of the river, in great floods to the general course of its channel." Additional funds were provided from time to time, and by the end of the century the Corps of Engineers

had expended about \$60,000 at Lawrenceburg and \$89,000 at Shawneetown to raise the levees to two feet above the crest of the 1884 flood. But these levees, constructed in sections by various agencies and raised on several occasions, did not prove satisfactory and were overtopped by several floods at a later date.¹³

Flood Control Controversy

President Theodore Roosevelt, 1901-1909, was the strongest advocate of improved waterways to occupy the White House since John Quincy Adams. In creating the Inland Waterways Commission in 1907 he directed that it should develop comprehensive plans for water resource development, including such features as navigation, flood control, and hydroelectric power generation.¹⁴

Colonel William H. Bixby, Central Division Engineer (ORD), and M. O. Leighton, Chief Hydrographer, U. S. Geological Survey, studied flood control reservoirs for the Inland Waterways Commission in 1907 and 1908. Mr. Leighton found that engineering advances since the 1870s had made safe reservoir construction feasible; that high construction and land costs could be distributed over a number of years; and that, ultimately, project costs, in comparison with benefits, would be nominal. Colonel Bixby agreed in general with Leighton's findings, but pointed out that federal law provided for improvement of navigation alone and that Congress "has been reluctant to enter upon an enterprise of such magnitude in cost and such great extension of Federal powers. . . ." ¹⁵

An extended dispute ensued among professional engineers and personnel of the Corps about the feasibility and practicability of federal construction of reservoirs for flood control. In 1910 and 1911 the National Waterways Commission re-

viewed the issue, found that the system would have greater prospects of success in the Ohio Valley than elsewhere in the United States, but reported:

The Federal Government has no constitutional authority to engage in works intended primarily for flood prevention or power development. Its activities are limited to the control and promotion of navigation and works incident thereto. The commission is one of the opinion that flood prevention is primarily a local problem. ¹⁶

Flood of 1913: the "Dayton Flood"

While engineers debated the proper methods for flood control and politicians discussed the legality of a federal flood prevention program, the devastating floods which swept the northern sector of the Ohio Basin in the spring of 1913 precipitated some action. Madison, Indiana, where the Ohio crested at 62.8 feet, one foot above the 1884 record, was the only reporting station on the Ohio in the Louisville Engineer District which experienced a record flood in 1913, but many records were established on the Upper Ohio and damages on the Lower Ohio were extensive. Damages at Louisville were estimated at half a million dollars, and downstream communities, especially Tell City and Cannelton, Indiana, and Hawesville and Uniontown, Kentucky, suffered very heavy losses. At Uniontown, a few miles above the mouth of the Wabash, for example, every house was flooded, the entire population was evacuated, and human suffering was termed "indescribable." Property damages were heaviest and most of the 361 deaths due to flooding occurred in the Muskingum, Miami, Scioto, and Wabash valleys. Damages were so extreme in the Miami Valley that the flood of 1913 became known as the "Dayton (Ohio) Flood."¹⁷



The 1913 Flood at Dayton, Ohio

In the aftermath of the flood, former President Roosevelt took the occasion to chide Congress for expending millions for relief of flood victims, but "not one cent" for solving the flood problem. He recommended intensive river basin planning for multiple-purpose water resource development and flood prevention. "All this might be done," he insisted, "by one act of the Federal Congress. We can lift the rivers out of politics by enacting a single adequate measure, establishing a policy, and providing continuing funds, exactly as was done in the case of the Panama Canal."¹⁸

Miami Conservancy District

An immediate result of the flood of 1913 was the organization of the Miami Conservancy District to plan and construct a flood control project for the Miami River Basin. About 300 lives and property worth an estimated hundred million dollars had been destroyed in the Miami Basin by the flood of 1913, and residents were prepared to support a flood control project funded by assessments on property benefited by the project. The Conservancy District conducted comprehensive studies of the Miami River flood problem and completed a project which was the pioneer in its field, and which, as such, set many precedents which had enormous influence on subsequent federal flood control planning.¹⁹

The Miami Conservancy District selected Arthur E. Morgan, an exceptionally capable and original civil engineer, as Chief Engineer. Morgan and his staff made preliminary plans for flood control in the Miami Basin, and a consulting board of twelve members reviewed the plans and reported favorably.²⁰

General Hiram Chittenden, the former Louisville District Engineer who had

been forced to vacate a house for a political appointee at the Louisville canal in 1893, served as member of the consulting board. After departing Louisville District, Chittenden had surveyed routes for a canal linking the Ohio with Lake Erie, one of which followed the Miami River Valley, and then had supervised the development of Yellowstone National Park and projects on the Upper Missouri River for a number of years. In the latter service, he had become the Corps' foremost proponent of storage reservoirs for flood control. Army officers were required to prove their physical condition by completing a fifty-mile horseback ride during the administration of Theodore Roosevelt, and while taking this test General Chittenden had suffered an injury which confined him to a wheelchair. He accepted a position with the Port of Seattle Commission, but after seeing the work in the Miami Basin and recognizing its significance he accepted the position of consulting engineer with the Miami Conservancy District.²¹

When General Chittenden came to the project, he told Arthur Morgan that he realized he had not much longer to live and expected his work on the project to be his last. General Chittenden made his last days count, working as long as twelve hours a day, seven days a week. Accompanied by his wife, he motored to every project site, and, because he was confined to his wheelchair, up to a dozen men were constantly employed in arranging, classifying, and delivering data to his room. And when all his questions were resolved and all weaknesses in design corrected, he became an effective proponent of the project.²²

The Miami Basin flood control plans for protecting the valley against floods 40% greater than that of 1913 chiefly involved improving the carrying capacity of the

Miami River channel by removing about five million cubic yards of materials and constructing earthen dams — Taylorsville, Lockington, Huffman, Germantown, and Englewood dams — with concrete outlets and spillways. The dams created “detention” reservoirs; that is, they did not create lakes except when flood conditions developed, and served principally to retard the flow of flood waters.²³

General Chittenden thought plans for the project were well conceived. It was also his opinion that flood control reservoirs could have wider application if flood control were coordinated with water storage for other uses — that is, he advocated multiple-purpose reservoirs for flood control, power production, water supply, recreation, and allied purposes and publicized the concept through articles in magazines and journals. As General Chittenden expected, he died shortly after completing his studies for the Miami Conservancy district. Before his death he wrote a particularly perceptive essay on the problems confronting those who would implement comprehensive flood control plans. For instance, he warned:

The greatest obstacles that the promoters of public work have to overcome are not those of nature, but of man. Nature is sometimes a stubborn adversary, but she always acts in the open, without subterfuge or indirection. But human ignorance, prejudice and self-interest are handicaps of a different character. Ignorance is least important, because it may yield to instruction. Prejudice — that is, prejudgment of a case and then sticking to it regardless of facts — is immeasurably worst. But self-interest is the most insuperable obstacle of all. Public measures are judged by their effect on the private pocket-book, and the rarest phenomenon in the world is a willingness to subordinate personal interest to the public welfare.²⁴

Construction of the Miami River Basin flood control project began in 1918; the dams were completed in 1921 and the

channel enlargement in 1922 at costs of about \$32,000,000. Construction costs were amortized in 1947, and by 1968 the dams of the project had retained flood waters 720 times, providing benefits in excess of costs by two to one. Its construction had considerable influence on national flood control policies and hydraulic engineering in general. General Chittenden's studies of multiple-purpose water resource development had also an unassessable but important influence in the evolution of the Corps program of water-use planning.²⁵

Ohio River Flood Board

While the Miami and other regional conservancy districts were planning flood control for smaller river basins, the Corps of Engineers was initiating comprehensive flood control planning at the national level. Just after the flood of 1913, the Chief of Engineers, in a confidential letter to Ohio Basin District Engineers, said it was his opinion that comprehensive planning for waterways improvement was in order, and, in advance of legislation to secure it, his office was requesting each Engineer District to make a confidential report on comprehensive project planning for streams in its jurisdiction. Each District in the Ohio Valley responded with reports of more or less completeness, but, in the absence of funding and staffing, the first comprehensive reports were quite limited in scope.²⁶

The Secretary of War also directed the Chief of Engineers to appoint a special Board of Engineers to inquire into conditions in the flood-damaged areas of the Ohio Basin and “report upon the most practicable and effective measures for prevention of damage by floods to works constructed for the improvement of navi-



Huffman Dam—Miami River Basin



gation, of interference with interstate commerce, and of other disastrous results thereof." Members of the Board, chiefly Ohio Valley District Engineers, inspected areas damaged by floods in 1913 and held public hearings. They could make no commitment to particular projects, but, as Major John C. Oakes, Louisville District Engineer, explained at a hearing at Fort Wayne, Indiana:

There are forty-nine men at work in my office in Louisville, and I want to say that if plans for flood prevention are made and estimates supplied with all the needed data our men will go through them and make such recommendations as they think are necessary.²⁷

The Ohio River Flood Board made its preliminary report in 1914. It stated that most flood control methods would have some application to meet variable conditions existing on different streams, and it strongly recommended that Congress authorize detailed basin flood-control planning, provide regional coordination for protection plans devised by various communities in the same river basin, and arrange a fair distribution of project costs. In the final report of 1916, the Board emphasized its opinion that flood control by the federal government should not be based "on the uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that may accrue in the protection of life and property from loss and in the prevention of the interruption by floods of general interstate commerce and the interference with the mails."²⁸

The "308 Reports"

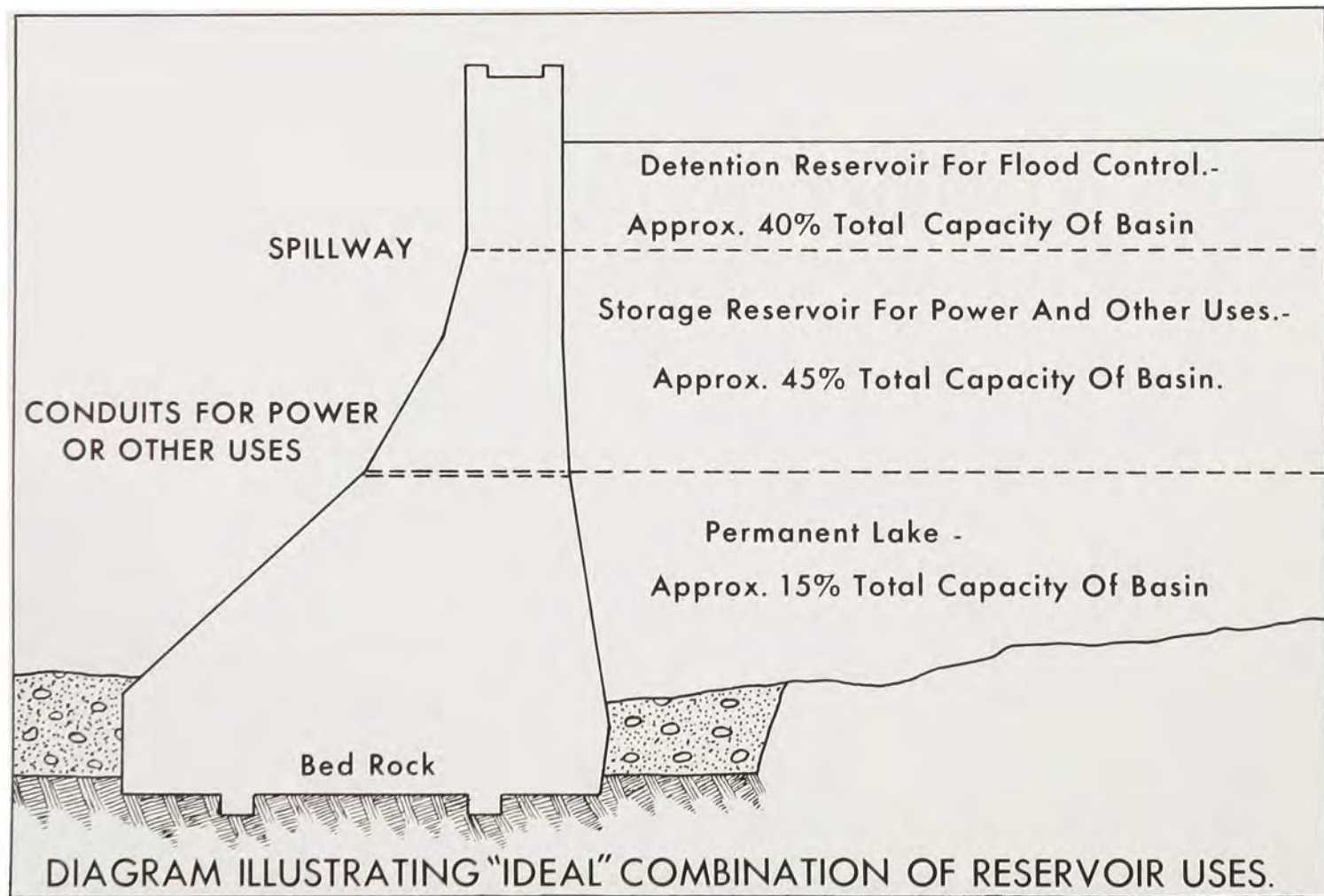
Congress was not prepared in 1916 to embark upon a national program of flood control, but resource surveys and planning for their utilization had many historic precedents. In 1917 Congress authorized

flood control studies on the Mississippi River, and during the next decade authorized comprehensive surveys on a few other scattered streams. In 1925 Congress directed the Corps of Engineers and the Federal Power Commission to submit cost estimates for basinwide surveys of practically every major river in the United States to develop comprehensive plans for navigation improvement in conjunction with hydroelectric power generation, irrigation, and flood control. These cost estimates were printed in 1926 as House Document No. 308, 68th Congress, 1st Session, and the surveys which followed therefore became known as the "308 Reports."²⁹

The studies recommended in House Document No. 308 were authorized on January 21, 1927, and the Corps of Engineers proceeded with what constituted an evaluation of the potential water resources of practically the entire United States; these represented the complete commitment of the Corps to the concept of multiple-purpose water resource development. The Engineers completed detailed surveys of each basin and then sought to determine the ultimate potential of the stream for navigation, irrigation, power production, flood control, and allied water uses; to determine what projects might be necessary, at what costs, and by what compromises between conflicting water-use interests. The Chief of Engineers said in 1930:

The entire design may not be worked out in our lifetime or in our children's lifetime. But the entire design will be known to us now; and (subject to inevitable minor changes as the work progresses) the development of the river . . . will . . . be along the lines that will ultimately accomplish the greatest good for the greatest number.³⁰

Louisville Engineer District completed "308 Reports" on a number of smaller ba-



DRAWING BY GENERAL HIRAM M. CHITTENDEN PRINTED IN HIS ARTICLE ADVOCATING MULTIPURPOSE RESERVOIRS. SEE CHITTENDEN, "DETENTION RESERVOIRS . . ." TRANSACTIONS OF AMERICAN SOCIETY OF CIVIL ENGINEERS, LXXXII (1918), PAGE 1486.

sins, such as the Tradewater and Salt valleys, and directed major efforts toward completion of authoritative studies of the Lower Ohio, Wabash, and Green river systems.

Wabash River Basin "308 Report"

Because of limited funding, the great size of the Wabash Basin, and the need for speedy completion of the surveys, the Louisville District adopted aerial photography, employing stereoscopic methods to delineate contour lines on mosaics of the photographs. This was one of the pioneer uses of this topographic mapping method which eliminated much of the slow, expensive, and laborious work of ground surveying. In a report on aerial methods, the District, emphasizing the close correlation of military and civil works missions, recommended aerial photography for Corps-wide topographic functions:

It is desired to call attention to the feasibility of the use of the stereoscopic method with limited control and less refinement for making maps of enemy country in time of war, maps for our own troops in rear areas, and coast defense maps not available at the beginning of hostilities. Unless the stereoscopic method is developed in time of peace, on large mapping projects with maps of various scales and contour intervals and diversity of terrain, the method will not be at its best in a period of emergency.³¹

Private interests and local governmental units had constructed earthen levees along the Wabash and its tributaries from the earliest days of settlement, and in the "308 Report" on the Wabash Basin, completed in 1933 and printed as a House Document in 1934, the Louisville District recommended levees as an effective flood control method for the Valley and also listed six acceptable sites for reservoirs for flood control. Because Congress at that date had not authorized construction of

flood control projects with federal aid and funds, it was originally expected that local and state government would finance and construct the projects, with the Louisville District providing overall supervision and the necessary engineering expertise for planning purposes. But the Depression of the 1930s had bankrupted many governmental entities, and funds for construction were simply not available. Colonel Gilbert Van B. Wilkes, Louisville District Engineer, met with the Governor of Indiana in 1935 and was informed that the State of Indiana could only offer its "moral support" to projects in the Wabash Basin. Colonel Wilkes reported that in the face of economic and political problems: "It seems self evident that the construction of the Wabash levees . . . is going to be complicated."³²

In the Wabash Basin, as elsewhere in the United States, it became evident in the 1930s that if effective flood control were to be achieved the federal government would have to provide funds to aid actual construction in addition to planning. The Corps and many members of Congress had recognized this fact by 1936. Congresswoman Virginia E. Jenckes, representative of a Wabash Basin constituency, in testimony before the House Committee on Flood Control in early 1937, pointed out that floods in the Wabash Valley were destroying property worth two million dollars annually, destituting farmers and forcing farm hands to join relief rolls; she recommended that plans of the Louisville District for flood control in the Wabash Basin be adopted by Congress and that federal funds be provided for project construction.³³

Green River Basin "308 Report"

The Louisville District's "308 Report" on the Green River and its tributaries,

submitted to Congress and printed in 1933, estimated that flood damages in the Green River Basin approached two million dollars annually, but, unlike the Wabash, the topography and hydrology of the Green River Basin were not generally suitable for flood control through levee construction. The District located seven feasible reservoir sites — three on the Barren River; two on the mainstream of the Green; and one each on the Nolin and Rough rivers — and asserted: “The best method of protection from floods would be the construction of a system of reservoirs . . .”³⁴

The Commonwealth of Kentucky and local government in the Green River Basin lacked the financial resources necessary for the construction of flood control reservoirs, and probably would not have constructed them in any case, for the costs of the projects exceeded potential benefits unless the benefits derived by reductions in flood crests on the Lower Ohio and Mississippi rivers, outside state jurisdiction, were also included in project economic computations. Several reservoir sites in the Green Valley were suitable for multipurpose projects for flood control and hydroelectric power production, and the addition of power generation as a project feature could have made the reservoirs economically feasible, but a market for the power did not exist at that time. Thus, as on the Wabash, flood control in the Green River Basin would not be possible for many years, perhaps never, unless the United States government was prepared to provide federal funds for the projects.³⁵

Ohio River Basin “308 Report”

The “308 Report” on the Ohio River, commenced in 1929 and completed in 1933, was based on the principle of flexibility; that is, the utilization of all appro-

priate flood control methods which were found desirable for economic and engineering reasons. The report listed many possible reservoir sites on tributaries, which could afford protection for tributary valleys and provide appreciable control over the mainstream of the Ohio, but a basic problem revealed by the study was that the effects of tributary reservoirs on mainstream flood crests decreased on the Lower Ohio. During major floods, the reservoir system might reduce crests at Cincinnati by as little as five feet and even less at Louisville and downstream communities.³⁶

The hydraulic regimen of the Ohio River was not often conducive to the method of channel enlargement to increase flood-carrying capacity; topographic factors prevented utilization of diversion channels, or floodways, like those planned on the Lower Mississippi River; and the costs of flood control reservoirs on the mainstream of the Ohio would substantially exceed potential benefits. The Army Engineers therefore proposed in the “308 Report” to achieve flood protection in the Ohio Valley chiefly by the construction of reservoirs on tributaries in combination with levees and floodwalls around highly-developed urban and industrial areas.³⁷

In the “308 Report,” the Corps recommended fourteen flood control reservoirs on tributaries — nine above Pittsburgh; three in the Kanawha Basin; and two on the Licking River — for immediate construction, but the same problem encountered in the Green and Wabash basins existed: there were few local and state government agencies capable or willing, to cooperate in financing and constructing the projects. Why, state and local authorities asked, should projects whose benefits cross political boundaries and ex-

tend to regions, sections, and to the nation be built with taxes on those who would receive only a portion of the benefits?³⁸

Flood Control Act of 1936

The Corps had completed most "308 Reports" by 1936, had recommended, and was ready to undertake, a number of high-benefit flood control projects. But funds for construction were unavailable. Then came the flood disasters of early 1936. About 200 lives were lost and property damages aggregated hundreds of millions of dollars as a result of widespread flooding in the northeastern United States in March, 1936. Floods ravaged the Potomac, Susquehanna, Delaware, and other valleys along the East Coast, and the Upper Ohio Valley experienced its greatest flood of record.³⁹

In Congress, where the issue of full federal participation in a national program for flood control had been debated for several years, the floods of 1936 galvanized support and Senator Royal S. Copeland of New York introduced a bill to affirm that flood control was a proper activity of the United States government and that flood control projects would be constructed in the interest of the general welfare of the nation. The historic Flood Control Act of June 22, 1936, incorporated these principles and committed the United States to a national flood control program, initially authorizing about 270 flood control projects.⁴⁰

No reservoir projects in the Louisville District were authorized in 1936, but several levee projects in the Wabash Basin were approved. By the end of 1936, the District had construction underway, chiefly with funds provided by the Depression Era recovery and relief agencies, on levee projects at Indianapolis, Anderson, Muncie, and Terre Haute, In-

diana. Studies were also underway preparatory to commencing construction of several projects on the mainstream of the Ohio River when the greatest flood of record on the Lower Ohio occurred in 1937.⁴¹

Superflood of 1937

The "Superflood" of 1937 crested on the Lower Ohio at nine, ten, and eleven feet above the records set in 1884. Paschal N. Strong, deputy to Ohio River Division Engineer (perhaps better known to the public as an author of adventure novels), said: "Rare meteorological conditions had created this calamitous inundation of almost Biblical proportions." But the cause was simple. It rained. Hard.⁴²

Rainfall equal to about half the normal yearly precipitation average fell in the Ohio Valley during January, 1937, resulting in by far the highest flood of record at every point on the Ohio River in the Louisville Engineer District. The Ohio was above flood stage at Louisville from January 16 to February 7, twenty-three days, cresting at 57.15 feet on the upper gage on January 27, about 10.4 feet above the 1884 crest.⁴³

The Cincinnati waterfront and Mill Creek Valley were mostly underwater for nineteen days. On "Black Sunday" gasoline tanks exploded, causing a two million dollar fire. The Ohio crested at 79.99 feet at Cincinnati, about nine feet above the 1884 record, on January 26. The crossriver towns of Newport and Covington, Kentucky, suffered proportionately. At Lawrenceburg, Indiana, a few miles below Cincinnati, damages were described as "prodigious." A citizen of Lawrenceburg later testified before a congressional committee that damages were far more than monetary:

The record refers to the horror and personal shock

sustained by the citizens, to the unprecedented suddenness and height of the water, to the trapping of people in their homes and upon roofs in winter with no heat, no light, no communication, the noises around them of rushing water and disintegrating buildings. These are, it is true, intangible losses, but none the less terrible and expensive.⁴⁴

About three-quarters of Louisville was flooded; 175,000 residents were evacuated; 90 flood-related deaths occurred; and property damages amounted to about \$50,000,000. Martial law was declared in the city and troop units were called in. Among them were the Fifth U. S. Engineers, who provided water-purifying equipment and built floating bridges. Some remarkable ingenuity was displayed in the construction of a floating bridge across Beargrass Creek — empty whiskey kegs were used as flotation devices.⁴⁵

The Indiana towns across the Falls were flooded and evacuated; about 76 square miles of Jefferson County outside Louisville were flooded; and below Louisville the only towns on the banks of the Ohio which escaped serious flooding were Henderson, Kentucky, and Newburg and Mount Vernon, Indiana. The towns where large numbers of buildings were washed away included Leavenworth, Indiana; West Point and Uniontown, Kentucky; and Shawneetown and Mound City, Illinois. A log kept by the lockmaster at Lock No. 44 near Leavenworth tersely, but effectively, told the story:

Jan. 21 Dam all down
 Jan. 22 Began snowing 5 p. m.
 Jan. 23 Depth of snow 5 in.
 Jan. 24 Oil house gone
 Jan. 25 Garage gone
 Jan. 26 Maneuver boat 252 gone
 Jan. 27 Warehouse gone
 Jan. 28 Most of Leavenworth gone
 Jan. 29 Leavenworth still leaving⁴⁶

About the only thing dry in Paducah,

Kentucky during the height of the flood was a cemetery. At the Irvin S. Cobb Hotel, a half mile from the river, water stood four feet deep in the second story — its upper floors served as a communication center for emergency operations. Paducah was 93% underwater, and 33,000 residents were evacuated.⁴⁷

Direct flood damages were estimated conservatively at four hundred million dollars; more than half a million people were driven from their homes in the dead of winter; flood-related deaths numbered in the hundreds; communication and transportation lines were severed; and normal business and industrial activities were suspended for weeks. The War Department spent more than five million dollars for flood relief and about the same amount for emergency work to protect existing structures. And the cost of relief activities of the American Red Cross aggregated more than seven million dollars. In the Louisville Engineer District alone, 1,986,000 acres of land were inundated; 156 towns flooded; 52 people died by drowning and flood-related accidents, and property damages approached a hundred million dollars.⁴⁸

Corps Flood Emergency Operations

The seriousness of the flood situation was not at first recognized at Corps headquarters in Washington — there were no record stages on the Upper Ohio where records had been established the previous year. Captain B. B. Talley, a photogrammetry expert at Wright Field (Wright-Patterson AFB), was ordered to fly over the flood, make photographic record, and report; and he alerted OCE to the fact that flood reports were not at all exaggerated. Photographic coverage of the flood continued throughout its duration to provide data for future planning.⁴⁹



Four views of Louisville and New Albany, Indiana during the Great Flood of 1937

Ohio River Division at Cincinnati opened an emergency communications center on the top floor of the *Enquirer* Building and began round-the-clock disaster coordination efforts. At Louisville, the District office building was cut off by flood waters, and District Engineer Dabney O. Elliott established a flood emergency headquarters at Evansville, Indiana, which also served as headquarters for Red Cross, Coast Guard, and National Guard units. On the lower river, the Golconda Flood District (Golconda, Illinois, near Lock No. 51), commanded by Colonel Charles P. Gross from the Engineer School at Fort Belvoir and Major F. F. Frech, military assistant from Huntington District, supervised emergency operations.⁵⁰

Each individual who was part of the Louisville District organization during the flood emergency of 1937, like most other citizens of the Ohio Valley at that time, has vivid memories of the long hours, the hazards, the amusing and not-so-amusing incidents of that flood fight.

Oren H. Bellis, who later became Chief of Operations Division of the District, recalled walking the Pennsylvania Railroad bridge from Louisville to Jeffersonville to evacuate his family. The U. S. Coast Guard shipped its fast picket boats, used to enforce prohibition on the Great Lakes, by rail to Jeffersonville, and Mr. Bellis joined one of them in patrols of the Ohio. Each picket boat had a crew of three and one Louisville District employee assigned to it. Mr. Bellis had the assignment of locating sandbags which might be used in the flood-fight and ascertaining the needs of isolated down-river communities. Getting down river was easy, but returning to Louisville at night under fog and ice conditions, with such debris as empty rail tankcars bobbing downstream on end like

corks, was somewhat hazardous.⁵¹

In the District office on the fourth floor of the Federal Building such staff as could get to the office was working without light or heat. Lanterns were procured, and folding cots were set up. On one of his river patrols, Mr. Bellis acquired some small coal oil heaters at Leavenworth, Indiana, for use in the office.⁵²

John H. Kurrasch, who subsequently had responsibility for developing District flood emergency plans and other planning activities, boarded a steamboat with a load of typhoid vaccine bound for the Lower Ohio. After delivery of medical supplies had been accomplished, he returned to emergency headquarters at the McCurdy Hotel in Evansville, Indiana. The hotel was accessible by road at the rear, and steamboats tied up to railings in front of the building. Kurrasch, Tony Fleming, and other Corps personnel at the scene constructed a wooden trestle as loading ramp for wheeling Red Cross disaster supplies onto the boats for distribution. Mr. Kurrasch recalled, with considerable amusement, loading such items as straw hats and white shoe polish on the relief boats. It appears the Red Cross determined that a typical country store contained all items which might be needed by flood refugees and purchased entire store stocks, rather than submit to delays necessitated by taking inventories and separating vital articles from those less useful.⁵³

Other Engineer bases were located at Tell City, Indiana, and Owensboro and Paducah, Kentucky, from which daily patrols were made by the Engineer fleet to aid in evacuation and provide other assistance as requested. The Engineer fleet transported flood refugees, Red Cross workers, volunteer flood-fighters, and military units, and moved relief supplies

to sites where needed. The Paducah Disaster Committee estimated the Engineer fleet saved no fewer than 5,000 lives in the Paducah area, and H. W. Richardson, editor of *Engineering News-Record* who was on the scene, wrote:

Conditions on this river are simply hell. The people simply refuse to evacuate ahead of the time of serious danger, and then the rescue load comes all at once. The army engineers stepped into this strange job of rescue and evacuation in great style. They are doing all that is humanly possible to bring order out of chaos: I have seen it happen right here today.⁵⁴

The collection of hydrologic data on the flood of the century was vital to future planning for flood control. On January 21, the Division Engineer telegraphed the District Engineer:

REQUEST STUDY EFFECT OF PROPOSED GREEN AND WABASH RIVER RESERVOIRS ON PRESENT OHIO RIVER FLOOD STOP STUDY SHOULD BE CARRIED ON COINCIDENT WITH FLOOD SO THAT AS NEAR ACTUAL OPERATING CONDITIONS AS PRACTICABLE MAY BE DEMONSTRATED STOP IT SHOULD COVER DAILY OPERATION SCHEDULED AND EFFECTS THEREOF ON OHIO RIVER STAGES STOP RESULTS SHOULD BE SUBMITTED TO THIS OFFICE AT EARLIEST CONVENIENT DATE⁵⁵

Reaction to the Superflood

As the above telegram indicated, the Corps expected the 1937 Superflood to generate additional public support for flood control measures. It did. President Franklin Roosevelt, members of Congress, and the Corps of Engineers received hundreds of letters expressing support and suggesting possible solutions to the flood problem. One citizen complained that the thousands of Civilian Conservation workers "turned loose in the Ohio valley" with picks and shovels had done their work well — the CCC drainage

improvement projects had caused rapid runoff and resulted in flood havoc. Another proposed the War Department organize a contest, as it had done for snag-removal in 1824, and offer a prize for the best plan to control Ohio River floods. The President also received a somewhat enigmatic telegram on January 30, 1937, which read: "HAVE THE OHIO FLOOD PROBLEM SOLVED STOP WILL WRITE YOU STOP WILL START ON THE MISSISSIPPI PROBLEM NEXT WEEK."⁵⁶

Civic, fraternal, and other organizations resolved their support for flood control, and one particularly interesting resolution asserted that flood control was also a "civil rights" measure in a sense. The Greater New York Federation, National Negro Congress, declared that Negroes, living in shacks on river banks because of segregation and economic disadvantages, suffered disproportionately because of the flood, asserted that over half the dead and homeless were black, and urged blacks throughout the nation to support flood control measures, resolving that "neither money nor governmental machinery be spared to carry through a comprehensive program" for controlling floods.⁵⁷

The House Committee on Flood Control resolved on February 10, 1937, that plans for the Ohio Basin be reviewed and updated to better provide flood protection for the communities of the Valley. The Corps completed a review within sixty days and recommended construction of levees, floodwalls, and channel improvement projects for the protection of 155 communities in the Ohio Basin, plus the construction of 45 reservoirs on tributary streams. The Chief of Engineers, in testimony concerning the revised plan before the House Committee on Flood Control, said that, while each project would be

fully justified from the standpoint of economics (benefit-cost ratio) before construction, he would not hesitate to recommend construction of the proposed projects on the basis of the "saving of human life and suffering, and in the prevention of the disturbance of the affairs of the Nation brought about by a flood disaster."⁵⁸

The Flood Control Act of August 28, 1937, provided nearly twenty-five million dollars for initial construction of projects selected by the Chief of Engineers from those listed in the Ohio Valley Flood Control Plan (published as Flood Control Document No. 1, 75th Congress, 1st Session). With funds provided by this appropriation, the major flood-control project construction program in the Louisville District and other Districts in ORD was launched. The Louisville Engineer District established a Flood Control Division in 1937, initially directed by Captain Miles Reber and Assistant Chief Samuel M. Bailey, the engineer who devised the concrete and steel "I" form floodwall to protect urban areas without the expensive land acquisition costs of earthen levees. By the outbreak of the Second World War in 1941, the Louisville District had nearly twenty flood control projects — levee and floodwall types — under construction.⁵⁹

Summary

The earliest efforts to develop some

measure of flood protection in the Ohio Valley were implemented by private interests and municipal governments, in some instances with state aid, to permit the utilization of low-lying agricultural property and avert damages at communities located in the flood plains. Repeated flood disasters, notably that of 1884 in the Lower Ohio Basin, brought federal aid for a few scattered levee projects in the Valley, and after the flood of 1913 the Corps recommended that comprehensive planning for flood control be authorized.

During the 1920s, the Miami Conservancy District completed a precedent-setting flood protection program in the Miami River Basin and the Corps of Engineers initiated comprehensive planning on a nationwide basis. The Corps "308 Reports" on the nation's waterways indicated what might be accomplished in developing water resources and preventing floods; and after the shocks of the record Ohio River floods of 1936 and 1937 Congress acted decisively, committing the United States to a national program of flood control and providing adequate funding for implementation of the Ohio River Flood Control Plan. In 1937 the Louisville Engineer District began construction of projects designed to prevent a repetition of the disaster of 1937. Flood control project construction thus became, in addition to navigation improvement, a major mission of the Louisville Engineer District.

CHAPTER XIII: LOUISVILLE DISTRICT MILITARY MISSION

From its inception in 1775 to about 1824, the primary mission of the Corps of Engineers was providing military support to the United States Army, chiefly by reconnaissance and map production, fortification construction, and combat engineering. The civil works mission, which included improvement of inland rivers, was assigned to the Army Engineers in 1824 because of the integral relationship between national prosperity and national defense capability, the need for improved transportation facilities for both commercial and military purposes, the need of the Army Engineers for construction experience during peacetime, and the fact that the United States Military Academy was the only school of engineering in the United States until 1825. Army Engineers operating in the Ohio Valley frequently performed both civil and military missions until the Civil War, when civil works projects were largely suspended and the Engineer officers and their staffs planned and constructed military installations throughout the Ohio Valley and elsewhere. From Appomattox to Pearl Harbor, 1865-1941, however, military construction in the Ohio Valley was performed chiefly by the Army Quartermaster and Ordnance Departments.

At the onset of the Second World War, in a major reorganization of the Army, the Construction Division of Quartermaster Corps was amalgamated with the Corps of Engineers organization, and each Engineer District was assigned responsibility for meeting the goals of an urgent, high-priority military mission, involving construction of airfields, troop cantonments, hospitals, and munitions and ordnance plants and depots for the Army and Army Air Force. This mission was suc-

cessfully completed in 1945 and civil works activities resumed their prewar importance in the operations of the Louisville and other Engineer Districts.

But the Louisville District had a continuing military mission throughout the Cold War, with a major construction effort during the Korean "police action," and for most of the quarter-century after 1945 the District performed the military construction and real estate program for the entire Ohio River Division. In 1970, as an economy measure, the District military mission was transferred to other Engineer Districts, but from 1940 to 1970 the District had completed a number of military support projects which had an immeasurable but significant influence on the success of American armies in the field.

Military Mission, 1866-1940

The fortifications constructed by the Corps of Engineers around Louisville, Cincinnati, and other cities and military depots in the Ohio Valley during the Civil War were sold or abandoned shortly after the end of hostilities, and by 1917, when another military construction program began in the Ohio Valley, the crumbling remains of the old fortifications had become tourist attractions — grim reminders of the bloody price paid for national unity. Of the Civil War installations, only Jeffersonville Quartermaster Depot continued operation in the Ohio Valley. From it supplies were dispatched to troops engaged in the Indian Wars on the frontier, the war with Spain in 1898, and the First World War. But the only project performed by the Corps of Engineers at the Depot was the construction of a levee to protect it from inundation and facilitate continued supply shipment during flood periods.¹

From 1865 to 1940, military construction in the interior of the United States was performed chiefly by the Quartermaster and Ordnance Departments of the Army; the military mission of the Corps of Engineers during the same period was confined mostly to seacoast fortifications and engineering in combat theaters. In national emergencies, such as those of 1898 and 1917-1918, Engineer officers and civilian personnel of the Louisville Engineer District received overseas assignments in connection with the Corps military mission, but the District civil works organization was not mobilized to any appreciable extent.

Military construction in the Ohio Valley during the First World War was completed largely by the Cantonment Division of the Quartermaster Corps. General George Goethals, who had served in the Ohio Valley as assistant to Colonel Merrill in the 1880s and who had directed completion of the Panama Canal, was Acting Quartermaster General in 1917. It was his opinion that military construction activities should be performed by the Corps of Engineers, and not the Quartermaster Corps. But this reorganization was not implemented at that time; instead, the Cantonment Division, Quartermaster Corps, was renamed the Construction Division and given independent status, reporting directly to the General Staff and the Secretary of War. After the Armistice in 1918, the Construction Division again became part of the Quartermaster Department.²

The Cantonment, or Construction, Division completed a large construction program in the continental United States during World War I, and two of its projects in the Ohio Valley formed the nucleus of the installations at Fort Knox, near Louisville, and Wright-Patterson Air Force Base, near Dayton, Ohio.

Camp (later Fort) Knox was selected for construction as a six-brigade artillery camp in 1918 because the site, thirty miles south of Louisville, was near the population center of the United States, was considered "healthful," and had a varied terrain suitable for artillery practice and large-scale maneuvers. The Quartermaster Department purchased 36,330 acres in Hardin, Meade, and Bullitt counties in 1918, and commenced construction on July 26, 1918. Original plans called for the erection of housing for 60,000 men and 27,000 animals; that is, facilities for six brigades of field artillery, two labor battalions, a veterinary hospital, a remount depot, two balloon companies, an aerial squadron, an artillery park, a training school for 10,000 officers, an ordnance depot, a supply depot, and a base hospital.³

Major W. H. Radcliffe, Constructing Quartermaster (equivalent to Area Engineer, or Resident Engineer), supervised the project and arranged for work to proceed seven days a week under contract. By the date of the Armistice, November 11, 1918, twelve thousand troops — of Artillery, the 29th Aero Squadron, and 31st Balloon Company — were stationed at Camp Knox. Contract work was suspended on December 21, 1918, and the Quartermaster Corps performed continuing work at the Camp with hired labor.⁴

Fort Knox was used intermittently after 1918 as a training center for the Fifth Corps Area and National Guard units, and in 1931 was selected by Major General Daniel Voorhis for training mechanized forces — thus, it became the "birthplace" of Armor. The Fort became better known to the public, however, as the site of the gold depository of the United States. In the months just prior to Pearl Harbor, a major expansion program began at Fort

Knox under the supervision of the Construction Division, Quartermaster Corps, and later the Louisville Engineer District. The number of structures at the post grew from 864 in 1939 to over 3,000 by 1942 to serve an enormous troop concentration.⁵

Construction at Wright-Patterson Air Force Base also began during the First World War. Colonel Edward Deeds, who was connected with both the Miami Conservancy District and the aircraft-production program of the Army, contacted Arthur E. Morgan, Chief Engineer of Miami Conservancy District, at Dayton and requested that he search for a site for a flying field. Morgan traveled the area in company with Orville Wright, one of the brothers who invented the airplane, and Wright chose the site of the first air flight after Kittyhawk for what was to become Wright-Patterson Field. The site was the property of the Miami Conservancy District, and citizens of Dayton arranged donation of the land for the airfield to the United States.⁶

The fledgling Army Air Corps, whose first commanding general was Mason M. Patrick, a former Corps officer who has served under Colonel Merrill in the Ohio Valley at one time, accepted the site, and construction began on May 27, 1917. This airfield eventually became known as Patterson Field. Land for Wright Field, adjacent to Patterson Field, was also donated by the Dayton Air Service Committee. Personnel of the Corps of Engineers made the original topographic survey of these fields and established bench marks, and construction was performed by the Quartermaster Department. These fields, as Wright-Patterson Air Force Base, became one of the major aeronautic research centers in the nation, and the Cincinnati and Louisville Engineer Districts built many facilities at the base, including complex

structures for aerospace testing purposes.⁷

Though Army Engineer troops were the first to enter combat and suffer casualties in France in 1917, and the Corps of Engineers was responsible for an enormous overseas military construction program, the civil works organization of the Corps and the Louisville Engineer District were not mobilized for a military mission during the World War I emergency. Events of the war did, however, have considerable influence on civil works activities in the District and waterborne commerce on the Ohio River.

Because the services of Engineers were required for the military mission, officers were too few in number to staff the civil works organization, and in 1918 and 1919 the Louisville District Engineer was Principal Assistant Engineer William H. McAlpine (the only civilian to serve as Louisville District Engineer). And because of the difficulty of employing labor during the war and the subsequent influenza epidemic civil works construction in the Louisville District, as elsewhere in the United States, was performed at reduced pace. Guards were also stationed at navigation structures and the lock force was armed to prevent sabotage during the war, but there is no evidence that any attempts were made in the Louisville District to damage the projects.⁸

Serious transportation problems developed during the course of the conflict — peacetime shipments continued and accelerated and to them were added troops moving to camps and ports of embarkation and military supply shipments. All of these wartime shipments went via highway or railway in 1917, resulting in a massive transportation snarl. At the same time, the inland waterways, whose commerce could have been doubled or tripled quite easily, were not utilized — 1917

was the nadir of commerce on the Ohio River. In 1917, Ohio Valley shipyards began a major construction effort to meet the demands for increased transportation facilities, and the Louisville District participated in efforts to increase use of the waterways.

On May 25, 1917, the Louisville District was ordered to locate any idle floating equipment in the Lower Ohio Valley which might be placed in service "to establish a system of freight movement upon the Ohio to relieve the congestion upon the railroads." District Engineer William H. McAlpine reported that because of a railroad car shortage, rail traffic in the Louisville District was nearly at a standstill. One shipper had hired the steamboat *Inco*, loaded it with freight destined for New Orleans, and sent photographs of the trip to various railroad presidents — shortly afterwards he got the railroad cars he wanted. McAlpine could find little idle floating equipment, and he recommended that a government-controlled or owned barge line, similar to that established on the Mississippi River during the war, be placed into operation between Louisville and Cairo to relieve railroad traffic congestion. Though his recommendation was not acted upon, it did indicate the seriousness of the situation.⁹

Though the Ohio River Canalization Project was only partially completed, in 1917 a technique was devised to increase the effectiveness of the completed sections. Traffic was gathered in slackwater pools above unimproved river sections, and at a signal sections of the movable dams were dropped to create a small rise, or wave, on which the vessels rode down river to the next slackwater pool. This technique and the congestion of alternate means of transportation contributed to the reversal of the downward trend of com-

merce on the Ohio. Commerce on the river in 1918 was fifty percent greater than that of 1917, and in 1919 the total ton-mileage on the Ohio, indicating long-haul traffic, climbed to six hundred million ton-miles, about double that of 1918. In 1920 ton-mileage on the Ohio topped the billion-mile mark.¹⁰

General Lansing H. Beach, the Central Division (ORD) Engineer who had introduced the "artificial wave" technique on the Ohio, became Chief of Engineers in 1920, and he asserted that one of the most important lessons of the war was the need for improved waterways:

The interest of the Federal Government in the construction of comprehensive road and interior waterway systems throughout the United States . . . is far greater as a measure of defense than for commercial reasons, great as is the necessity of these for the latter purposes. This statement is made advisedly, for the preservation of the life of the Nation is the central government's greatest responsibility in peace and in war, and hence every facility should be developed to allow a successful defense to be made. It fortunately happens that roads and waterways constructed solely to meet the needs of commerce are generally well adapted to the needs of defense, and the immediate interests of the people can be counted on to secure support for this great preparedness measure.¹¹

The lesson was not lost upon Congress, which in the Transportation Act of 1920 pronounced that it would be the policy of the United States to "promote, encourage and develop water transportation service and facilities . . . and to foster and preserve in full vigor both rail and water transportation." Congress directed the Corps of Engineers to conduct investigations of floating plant design, water terminal facilities, and water and rail interchange connection and develop plans for enhancing use of the nation's waterways; it also provided substantial appropriations for completing the Ohio River Canalization Project. By

1941 the Ohio River and other inland waterways were in a much improved condition for service in a national emergency.¹²

Early Military Construction, 1940-1941

When the thud of bombs at Pearl Harbor brought the United States into the Second World War, the Corps of Engineers was in the throes of consolidation, for on December 1, 1941, the President had directed merger of the Construction Division, Quartermaster Corps, into the Corps of Engineers organization within fifteen days. The Louisville Engineer District, engaged at the onset of war in the initial phase of flood control project construction, suddenly became responsible for a huge military mission, and received what was doubtless the greatest challenge of its history, for rapid mobilization of national resources was imperative. The District was, however, not completely unprepared for the assignment.¹³

The Corps had been assigned portions of the Airport Construction Program for the Civil Aeronautics Administration (C.A.A.) on October 15, 1940, and on November 20, 1940, construction of installations for the Army Air Force to provide airfields and training schools for 30,000 pilots was assigned to the Corps.¹⁴

The airfield construction program for the C. A. A. in the Louisville District involved projects of a quasi-military character at Kokomo, Indiana, Bowling Green and Paducah, Kentucky, and Standiford Field at Louisville. The Standiford Field (originally Municipal Airport No. 2) project was built on property owned by Jefferson County outside Louisville. The county had made the site available to Vultee Aircraft Corporation and Curtiss-Wright Corporation, which had factories

adjacent to the site and were commencing the production of military aircraft. The project, commenced on June 16, 1941, consisted of construction of runways, fencing, lighting, and drainage systems.¹⁵

The typical C. A. A. project in the Louisville District involved the construction of 150-foot wide runways, each 3,900 feet long, with a limestone base surfaced with asphalt, and pertinent auxiliary structures. The total amount of pavement at one field was 140,000 square yards — by the use of locally available materials, costs for both materials and labor were held to \$1.70 per square yard. Several of these fields became the nucleus of the commercial airfields serving nearby cities after the war. Standiford Field became the terminal for airlines serving the Louisville metropolitan area.¹⁶

The original airfield construction undertaken for the Army Air Force in the Louisville District included Godman Field at Fort Knox and Bowman Field at Louisville. Godman Field was commenced by the Quartermaster Corps with W. P. A. labor on January 23, 1940, and the project was taken over by the Louisville District in 1941. Five surfaced runways of 150-foot width and up to 5,400-foot length were built for the use of an observation squadron attached to the Armored force at Fort Knox. Bowman Field, originally a Louisville commercial airport, was taken over by the Army Air Force in August, 1940, and construction for military purposes was commenced by the Quartermaster Corps and continued by the Louisville District. Additional runways were built and about 120 buildings erected to permit use of the Field as a replacement and supply depot for the Air Force, as an air crew and combat glider training base, and, near the end of the war, as a convalescent hospital for wounded fliers.¹⁷



Construction of Standiford Field at Louisville

*Military Construction Administration,
1941-1945*

The military construction office in the Louisville District was part of the District Navigation Branch until early 1942, when a separate Military Branch was established to supervise the numerous large projects transferred to the District from the Construction Division, Quartermaster Corps, on December 15, 1941. The transfer was accomplished with minimum disruption — the general procedure was to appoint the former Constructing Quartermasters at projects as Area Engineers, who reported to the District Engineer, instead of the Quartermaster Department.¹⁸

During initial phases of the emergency, much construction was accomplished in accordance with standardized plans, but design for outside utilities was a unique problem at each project. At each major work-site a self-sustaining organization was established to handle accounting; they reported to the Accounts and Audits Unit at the District Office which produced consolidated District Fiscal reports. The magnitude of mission expansion was almost overwhelming, for during 1942, the peak year for military construction in the Louisville District, daily expenditures often exceeded more than a million dollars, which was almost as much as the District had expended in an entire year on civil works prior to the commencement of flood control projects. Cost reports for about thirty civil projects and fifty military projects were prepared on a monthly basis by the Accounts and Audits Unit (which became part of the District Fiscal Branch in 1944).¹⁹

The immense scope of the military mission required substantial increases in personnel, and office space requirements forced various sections of the District Office staff to relocate in buildings scattered

throughout Louisville. Personnel turnover was also rapid. At least 569 former Louisville District employees were serving in the Armed Forces by 1945, and five — Clements H. Diepenbrock, Daniel F. Hilliard, Earl J. Murphy, and Allen C. Schanz — died in that service. The military mission was so urgent that civil works were almost suspended; of the 377 staff members at the District Office, 367 were engaged in some capacity in performing a portion of the military mission. The only significant civil works projects under construction in Louisville District in 1942 were flood protection projects at Paducah, Jeffersonville, and Evansville.²⁰

The principal Corps mission in 1942 was in support of national efforts to get troops trained, equipped, armed, and supplied for embarkation to North Africa, Europe, and the Pacific; thus, 1942 was the peak year for military construction in the continental United States and in the Louisville Engineer District. During that year the military mission conformed closely to the District civil works boundary, but in late 1942 a reorganization was undertaken to make Engineer Division military construction boundaries conform to Service Command boundaries.²¹

The Ohio River Division, which included the Louisville District, became, in effect, the construction agency for the Fifth Service Command, and Division offices were transferred from Cincinnati to Columbus, Ohio, also the headquarters of the Fifth Service Command. Service Command boundaries tended to follow state boundaries, and the reorganization resulted in an enlargement of the area of the Louisville District for military construction. The District took over military construction in Indiana, becoming responsible for Baer Field and Camp Thomas Scott at Fort Wayne, and New

Haven, Kingsbury, and Wabash River Ordnance plants, formerly in the Chicago and Detroit Engineer Districts. Chanute Field and George Field in Illinois were transferred from Louisville to the Chicago Engineer District.²²

Military projects were generally initiated by a construction directive from the Office of the Chief of Engineers, specifying the work to be accomplished, the installation where the work was to be done, and the amount of funds available. Projects completed by the Louisville District during the war consisted chiefly of troop cantonment structures, munitions and ordnance plants, supply depots, airfields, hospitals, modification centers, and the remodeling of buildings, such as the Gibbs-Inman Building in Louisville which became the District Office building in the postwar era.²³

Airfield Projects

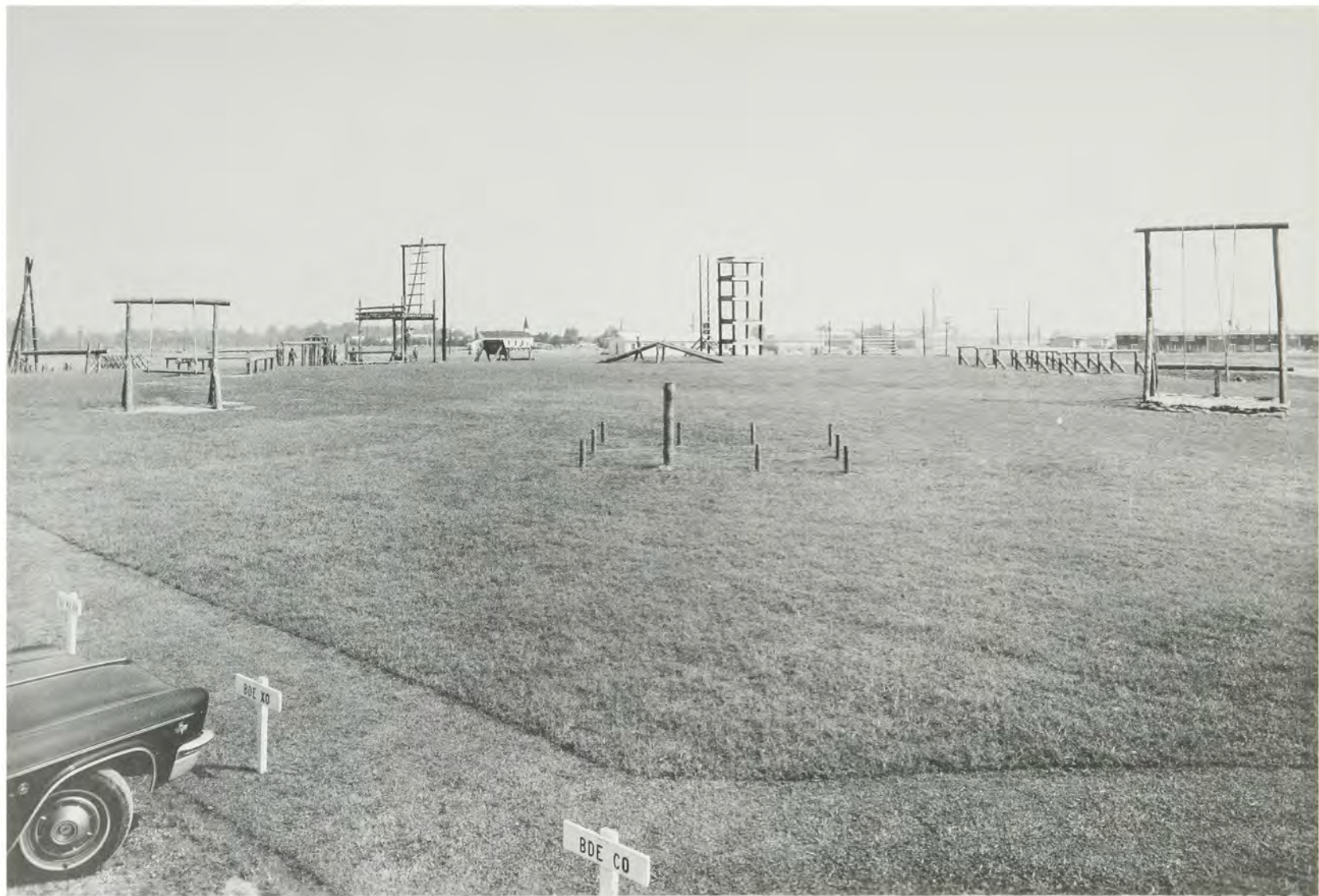
In addition to the C. A. A. and U. S. A. A. F. projects commenced in 1940 and 1941, other airfields were constructed and expanded by the District during the course of the war. Two schools for bomber crews were built near Seymour, Indiana, and Lawrenceburg, Illinois, in 1942. The Seymour Air Force Advanced Twin Engine School project consisted of construction of technical and operational buildings and military housing for a school of 380 officers, 475 cadets, 13 nurses, and 2,324 enlisted men, and Freeman Army Airfield — four runways and parking aprons — and five auxiliary landing fields for training purposes. Construction began on June 5, 1942, and was completed for use at a cost of fifteen million dollars within a year. The Twin Engine School at Lawrenceville consisted of similar facilities, including George Army Airfield and three auxiliary fields. It also was completed in late

1942, at costs of about ten million dollars.²⁴

Troop Cantonment Projects

In late 1941 the Louisville District received from the Quartermaster Department several large construction projects at Fort Knox and Camp Breckenridge, Kentucky, and Camp Atterbury and Fort Benjamin Harrison, Indiana. It continued construction of various facilities at each of these cantonments throughout the war. Several projects were also completed at Camp Campbell, Kentucky, and Camp Thomas Scott at Fort Wayne which were added to the Louisville District mission as result of the reorganization in late 1942. The first construction at each of these camps was the rapid erection of mobilization-type, two-story, frame barracks for troop housing, and related facilities — utility lines, roads, kitchens and mess halls, firehouses, fencing, warehouses, and motor-vehicle storage space.

Fort Knox was already occupied by Army Armor, but the number of structures on the base was tripled between 1939 and the end of 1942. Camp Atterbury, near Indianapolis, and Camp Breckenridge, near Morganfield, Kentucky, were designed as Motorized Triangular Division cantonments. The Camp Atterbury project, for example, provided originally for the construction of 520 mobilization-type buildings and a semi-permanent hospital on about 40,000 acres of land thirty-miles south of Indianapolis to house a Triangular Division of 35,816 enlisted men and 1,642 officers. Design was accomplished by a contracting firm, construction by five contractors, and work was supervised by Area Engineer Major Rees W. Willard with a 53 member staff. The office of the Inspector General reported in April, 1942,



Confidence Course at Fort Campbell



Barracks Buildings at Fort Campbell



Hospital at Wright-Patterson Air Force Base



Nuclear Test Facility at Wright-Patterson Air Force Base

that at Camp Atterbury: "Work in place was well performed and materials being used were in compliance with contract requirements. Buildings and other structures showed evidence of careful inspection."²⁵

Construction performed after the completion of basic facilities at Camp Atterbury in 1942 consisted of such subprojects as the construction of an airfield, a practice bombing and gunnery range, and conversion of the camp hospital in 1945 to a general hospital (Wakeman Convalescent Hospital), involving the building of classrooms, housing, and laboratory facilities for medical staff and recreation facilities for patients. District projects at Camp Breckinridge and other troop-training cantonments were quite similar to those at Atterbury.²⁶

Ordnance and Munitions Projects

The troops had to be furnished with the proper arms and ammunition for the tasks ahead of them; and the Corps constructed scores of ordnance and munitions installations across the nation. During the early buildup for the invasions in Europe and the landings on Pacific Islands, ordnance and munitions plants were constructed on a "crash" basis. Work on this sort of project tapered off in 1943 and 1944, and then, because ammunition requirements had been under-estimated, a renewed munitions plant construction program, described as "critical," was instituted in 1945. Even a mere listing of this type project completed in the Louisville District is quite lengthy: Ohio River Ordnance Works at Henderson, Kentucky; Hoosier Ordnance and Indiana Ordnance at Charlestown, Indiana; Evansville Ordnance Plant at Evansville, Indiana; Blue Grass Ordnance Depot at

Richmond, Kentucky; Falls Creek Ordnance Plant at Indianapolis; Vigo Ordnance Plant and Terre Haute Ordnance Depot at Terre Haute, Indiana; and Kingsbury Ordnance Plant near LaPorte, Indiana. The Engineers also constructed many related projects, such as a building for expansion of facilities at Warner Gear Division of Borg-Warner Corporation at Muncie, Indiana, and ordnance-testing facilities at Jefferson Proving Ground, Madison, Indiana. A description of a few of these ordnance installations will indicate their general character and scope.

The Ohio River Ordnance Works project involved the design, engineering, construction, and preparation for operation of a plant for the manufacture of anhydrous ammonia on an 882-acre site three miles west of Henderson, Kentucky. Construction commenced on April 22, 1941, and was completed two weeks ahead of schedule on September 30, 1942. There were no fatal accidents during construction; and in spite of inflationary rises in materials costs, the added costs of increased security after declaration of war, and a vastly increased amount of overtime due to speedup, the project was completed within original cost estimates. Buildings at the project were of temporary (five-year life) construction; they housed one production line for manufacturing liquid anhydrous ammonia with a rated capacity of 150 tons per day.²⁷

Indiana and Hoosier Ordnance plants at Charlestown, Indiana, were located within two miles of each other. Indiana Ordnance plant was a \$75,000,000 smokeless powder plant constructed in 1941 and put into operation in early 1942 by the E. I. du Pont de Nemours Company. Six production lines, each with a 100,000-pound daily capacity, gave some

credence to the claim that it was the largest powder producing plant in the world. The Louisville District built a number of structures at Indiana Ordnance; for example, in 1945, with the services of a thousand prisoners of war because of a labor shortage, the District supervised construction of a plant to produce rocket powder. Hoosier Ordnance Plant, originally designed for loading artillery powder charges, was also completed in early 1942.²⁸

The Evansville Ordnance project consisted of renovation of a Chrysler Corporation plant and construction of additional facilities for the production of .45 caliber ammunition. Vigo Ordnance near Terre Haute was built in 1942 to furnish shell detonators and primers. And Fall Creek Ordnance at Indianapolis was designed for the manufacture and processing of armor plate.²⁹

Jefferson Proving Ground, constructed near Madison, Indiana, was built for acceptance testing of ammunition, bomb components, and pyrotechnics — meaning the actual firing of samples to determine ballistics, functioning, and storage-handling characteristics before issuance to troops. The Quartermaster Corps let contracts for the project in September, 1941, and the Corps of Engineers initiated construction on December 19, though official notice to proceed was not given until a week later. The change of command was handled quite simply at the project: the Constructing Quartermaster was appointed Area Engineer on December 16 and reported thereafter to the District Engineer. Problems experienced at the project included the usual difficulty in employing labor, piecemeal construction, and such unforeseen contingencies as the rise in female personnel employment, which required design

changes to provide additional lavatories and other facilities.³⁰

Hospital Projects

Hospital and related medical facility construction was also an important part of the military program, for troop cantonments required camp hospitals, and general hospitals were required to serve the sick and wounded soldiers. The largest projects in the Louisville District in this category were Billings General Hospital at Fort Benjamin Harrison near Indianapolis, Darnall General Hospital at Danville, Kentucky, and Nichols General Hospital at Louisville. Construction began at Billings General Hospital in 1941; it opened for occupancy on June 30, 1942, though it was not actually completed until November 1. Billings Hospital involved construction of a 1060-bed hospital, a medical technicians' school, and a field hospital unit in about seventy frame buildings with asbestos shingle siding and light, roll-felt roofs.³¹

Darnall General Hospital at Danville was leased from the Commonwealth of Kentucky for conversion to a military hospital in June, 1942; and the Engineers constructed adjacent facilities for mental patients. Nichols General Hospital was a mobilization-type project (five-year life buildings) constructed by the District just south of Louisville. Work commenced on June 1, 1942, at Nichols Hospital on a thousand-bed facility and field hospital unit; the project was completed on schedule on November 15, 1942. In 1968, some of the structures built in 1942, designed for five-year service, were still in use.³²

Demobilization

The military construction program in the Louisville District, except for a few

urgent projects at munitions plants, tapered off in 1944 and 1945, as the scope of the Army Engineers' mission in overseas combat theaters increased. General Eugene Reybold, Chief of Engineers during the war, declared that by 1943 the Engineers "could move the Army and the Air Forces any damned place there were Germans and Japs left to destroy, whether it meant building a truck road around the Himalayan Hump, rebuilding the wrecked ports of Italy, or ferrying heavy tanks across a flooded river. We were the men who could do it because, by God, we were getting it done."³³

In 1944 the District centralized its military construction program to reduce administrative costs by dispensing with many of the Area Engineer offices at major projects and providing construction inspection through mobile teams dispatched from the District office in Louisville to projects in Kentucky and from an Area Engineer office at Columbus, Indiana, to projects in the Hoosier State. Office space had been at a premium in Louisville during mobilization and various sections of the District Office staff has been dispersed in buildings throughout the city. As the end of the war approached, these sections were gradually brought back together and moved into space vacated by the Air Force and other agencies in the Gibbs-Inman Building.³⁴

Through mobilization of the decentralized District and Division organizations, which were in close contact at the local level with engineering and construction firms and were fully cognizant of locally available materials and construction equipment, the Corps of Engineers was able to mount an emergency construction push to complete two and a half billion dollars worth of military facilities in 1942, reaching a peak rate of

\$720,000,000 per month by mid-1942. By the end of the war, construction worth eleven billion dollars had been completed by the Corps in the continental United States. Military supply procurement was also accomplished by the Engineers at a rate of about two billion dollars per year. Corps records show that 5,300 engineering and construction firms participated in the military construction program, while Engineer troop strength reached three-quarters of a million men.³⁵

Led by hard-charging District Engineers — Colonels Henry Hutchings, Jr., Henry F. Hannis, Jesse H. Veal, and Gilbert Van B. Wilkes — the Louisville District operated in near emergency status during the war, commencing and rapidly completing immense projects under directives which called for completion within thirty, sixty, or ninety days. The District was faced with concurrent shortages of labor, construction equipment, and high-priority materials, but it persevered, utilizing alternative resources, employing large numbers of women to alleviate the manpower shortage, and resorting even to the use of prisoners-of-war as a labor force. The District accomplished the largest construction program in its history and met, almost without exception, the goals assigned at each project.

Perhaps one incident best illustrates the ruthless pressures under which the District staff operated during the Second World War. On a Friday before Labor Day, the Louisville District was advised that German prisoners would arrive at Austin and Rochester, Indiana, at 8:00 a.m. on the Tuesday after Labor Day. The District was instructed to have two internment camps complete and ready for occupancy by the time the prisoners ar-

rived. Each camp required tent platforms, mess halls, double fence stockades, water supply, and sewerage facilities. Over that long Labor Day weekend the District staff worked day and night. Pipe and barbed wire were at a premium, but the District maintained a complete listing of surplus materials from completed projects and assembled the necessary items from stores on hand. The internment camps were thrown up within a seventy-two hour period and were ready for occupancy when the prisoners arrived.³⁶

Emergency construction directives and mandatory orders for swift completion of projects to a usable state forced hasty and impermanent construction at many military projects. But swift completion and serviceability in time of national emergency were just as important as economy and durability on peacetime civil works projects. Under the conditions described above, many expedients were adopted which would not have passed the strict rules of accountability applicable to normal civil works activities. The position taken by the District Engineers and field engineers during the emergency was that the jobs should be completed first; paper work could be argued about later. Disbursements were made without much question for many unusual items such as "removing jerk from government car," a circus tent for temporary office space, and, in the face of gasoline and tire rationing, mules complete with harness and riding horses with saddles.

When the Office of the Comptroller General investigated fiscal matters in the Louisville Engineer District in 1944, the Secretary of War intervened. The Secretary commented;

An investigation of the matter emphasizes the

difficult situation created during the early part of the War when, by act of Congress, the great volume of construction work of the Army was transferred from the Quartermaster General to the Chief of Engineers, and when speed was mandatory. Reports of the officers on the job greatly stress the tremendous increase of duties thrown upon the employees available at a time when such personnel was subject to inductions into the service, enlistments, transfers to more remunerative positions, and the many other processes which rapidly depleted the forces in the field of their best men. There is also to be considered the proposition that a review, after the fact, of the activities and procedures directed under such extreme pressures will, without much difficulty, disclose many mistakes.³⁷

District Military Mission, 1945-1950

At the end of the Second World War, the civil works program of the District rapidly resumed its prewar pace. Expenditures in the District for military construction, which had reached a high of a million dollars per day in 1942, amounted to less than half a million dollars in 1946. In 1947 the Cincinnati Engineer District was phased out, and the Louisville District assumed military construction contracts previously administered by the Cincinnati District amounting to about nine million dollars. And in 1948 the District was assigned responsibility for design and construction of Veterans' Administration hospitals estimated to cost about eighteen million dollars each. Real estate functions, involving land acquisition and disposal, had been centralized at Ohio River Division during the war. In 1947 a Real Estate office was re-established at Louisville District, with responsibility for District civil works, the entire Ohio River Division military construction program and for the Atomic Energy Commission (A.E.C.) in the Lower Ohio Basin.³⁸

The military mission of the District was described as "routine" from 1945 to 1950.

The principal activities included additional airstrips and some esoteric aerodynamic testing structures at Wright-Patterson Air Force Base, airstrips at Fort Campbell, Kentucky, a fume-elimination project at Morgantown Ordnance Works in West Virginia, and minor projects — armories and storage buildings — for National Guard units.³⁹

*Korean "Police Action" Construction,
1951-1953*

When the Cold War waxed hot in Korea in 1950, the Corps of Engineers commenced a "crash" program to meet the requirements of the American forces engaged in that "police action." Major rehabilitation programs, or "retreading" as the expression went, were instituted at Indiana and Hoosier Ordnance plants at Charlestown and Jefferson Proving Grounds at Madison, Indiana. Other projects included warehouses at Lexington, Kentucky, Signal Depot; a parachute-repair shop and a box-crate shop at Jeffersonville Quartermaster Depot; magazines and other facilities at Blue Grass Ordnance Depot; and about fifty million dollars worth of barracks and other housing at Fort Knox and Fort Campbell. By 1953 the monthly expenditures of the Louisville District had risen to over seven million dollars. During the Korean incident a Supply and Procurement Division was also organized in Louisville District, with 256 employees at the peak in 1952, to purchase supplies for the troops in Korea.⁴⁰

District Military Mission, 1953-1970

After the truce was signed in Korea in 1953, the Louisville District military mission again began to taper. The District was assigned a real estate mission for the National Aeronautics and Space Ad-

ministration (NASA) in 1958, and in the same year directed construction of Strategic Air Command (SAC) facilities at Wright-Patterson Air Force Base. The work at Wright-Patterson required the design and construction of some unique structures never before built, and was to be a continuing mission of the District throughout the 1960s. Projects included the installation of a nuclear reactor to subject materials to radiation testing; the construction of an optical facility for equipment which included a 100-inch mirror — second largest in the United States at one time; and a sonic-fatigue testing facility. The latter project was designed to house large numbers of sirens developing up to a million watts of sonic power; sirens were used to create a vibration capable of shattering the material being tested. The District had to design and construct a structure which would not itself be destroyed by the tests.⁴¹

President John F. Kennedy in 1961 called for rapid implementation of a Civil Defense and National Fallout Shelter Program. The Corps of Engineers was assigned a major role in this program because of its experience in handling disaster situations, its engineering expertise, and its close contact with local authorities through its decentralized organization. The Louisville District participated in an urgent program to locate, mark, and stock structures suitable for service as fallout shelters — over a hundred million fallout shelter spaces were established across the nation. The District also prepared, for its assigned region, contingency plans for post-attack recovery, including provisions for repair of transportation facilities and public utilities, rescue operations, debris clearance, damage assessment, radiation detection and decontamination, mass burials, and other emergency functions. The

full value and effectiveness of this contingency-type program can not be calculated in advance of need, and it is one project which personnel of the Corps sincerely hope will never be tested by actual use; however, the loss of public interest in the program does not detract from its potential value.⁴²

As an economy measure, twelve Engineer Districts in the United States were relieved of military construction and real estate functions in 1961; and during this reorganization the Louisville District was again assigned the duty of performing these functions for the Ohio River Division. But the scope of the District military mission dwindled during the 1960s — from sixty-nine project work-sites in 1961 to thirty-one in 1965. The war in Viet Nam had little effect on the District military mission. There were a few rush projects for the construction of additional facilities at Fort Campbell and Fort Knox, but there was no crash construction program similar to those of the Second World War and the Korean War.⁴³

Partially as a result of this decrease in military construction volume in the Louisville District area of responsibility, the Office of the Chief of Engineers determined in 1970 that the mission could be accomplished at reduced administrative costs by further centralization of the program. Responsibility for military construction and military real estate functions in Ohio River Division was transferred from Louisville to the Omaha (Nebraska) and Baltimore (Maryland) Engineer Districts. As of July 1, 1970, the Omaha District became responsible for the Corps military mission in Illinois and Indiana, and the Baltimore District for Ohio, West Virginia, and Kentucky.⁴⁴

Summary

After performing a military mission for almost a third century, 1940-1970, except for continued Civil Defense support activities, the Louisville District became a strictly civil works organization on July 1, 1970. The military mission had a certain excitement about it not associated with civil works — the urgent crash construction programs of the early 1940s and 1950s, the esoteric engineering requirements and challenges of ordnance works, aircraft and aerospace facilities, and other military installations, and the immediate involvement in national defense efforts. Personnel of the Louisville District took great pride in its achievements while performing the military mission; and historical evidence indicates that this pride was probably justified.

Assessing the total value of the work completed by the District as part of its military mission — its contributions to the success of American armies in the field; the amount by which its work increased the security of the citizens of the United States — is difficult, if not impossible. Perhaps the same assignments could have been accomplished equally as well by another similar agency. On the other hand, there was no similar agency. Certainly there can be no doubt that the experience gained by District personnel in performing large civil works construction in peacetime had significant value when rapid large-scale mobilization construction for military purposes became necessary in a national emergency. And, over a long time-span, the civil works program itself was a major military mission, for it was designed to increase national prosperity and enhance the economic well-being of Americans — elements absolutely essential to effective national defense.

CHAPTER XIV: WATERWAYS NAVIGATION RENAISSANCE

As predicted by the Corps, and just as emphatically denied by opponents, the Ohio River Canalization Project completed in 1929 stimulated renewed use of the Ohio River for commercial transportation; and gradually a new traffic developed on the river and some of its tributaries as industries located on the riverbanks to take advantage of low-cost waterways transportation and dependable water supply. In 1935 the costs of moving non-metallic minerals on the Ohio was less than a third and steel products less than a quarter the comparable rail rates.¹

The great bulk of commerce on the Ohio before 1941 was shipments of coal and steel, but during the Second World War shipment of petroleum products began on a large scale. Traffic diversification continued after the war, and by 1956 commodities using the river were too numerous to list. Before 1941 traffic was largely downstream; by 1956 the amount of up and down stream tonnage was about equal. Commercial traffic on the Ohio, which had verged on extinction in 1917, was overwhelming the locks and movable dams of the canalization project by 1956, and construction of a project to modernize navigation facilities on the Ohio commenced.²

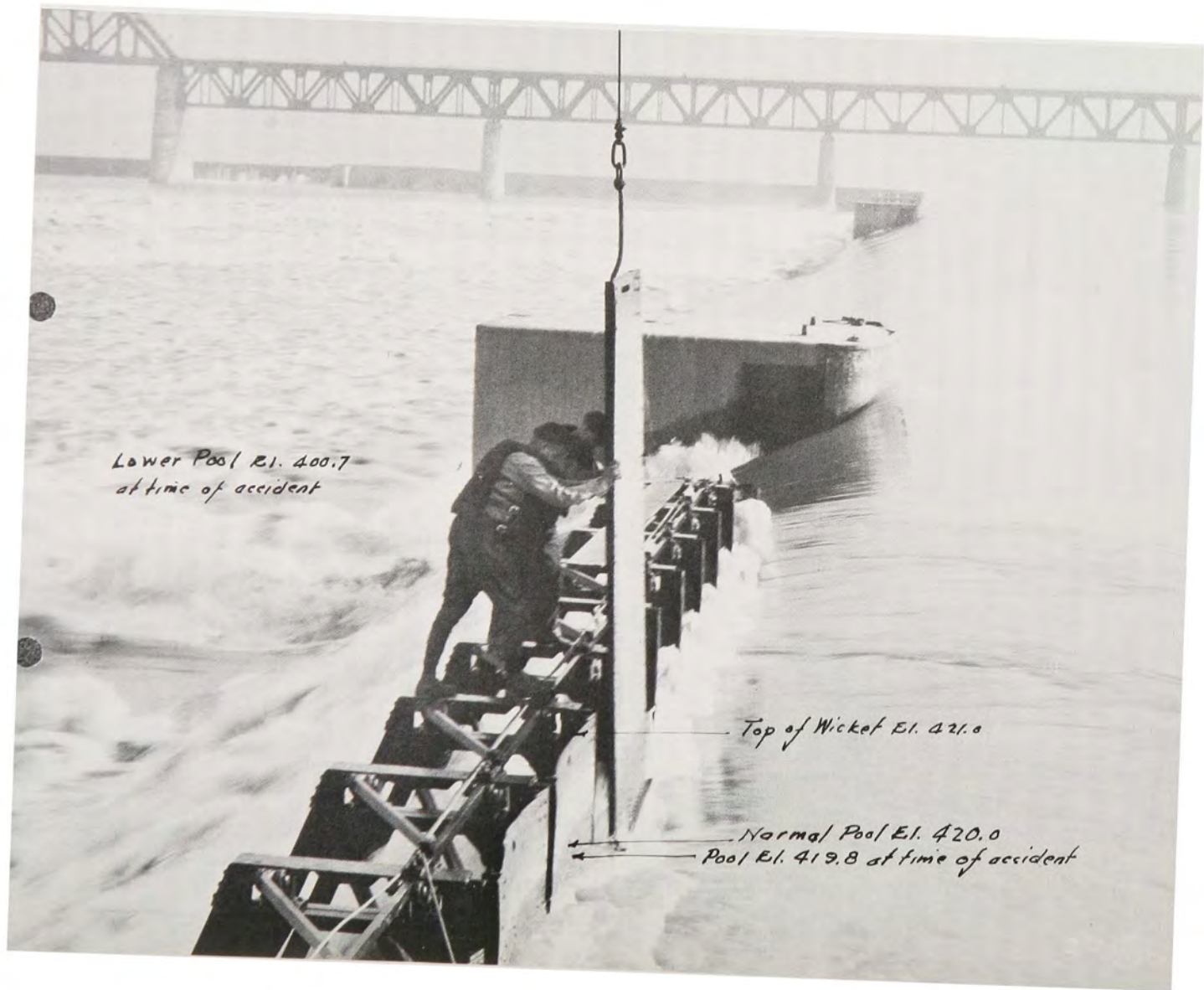
Canalization Project Operation

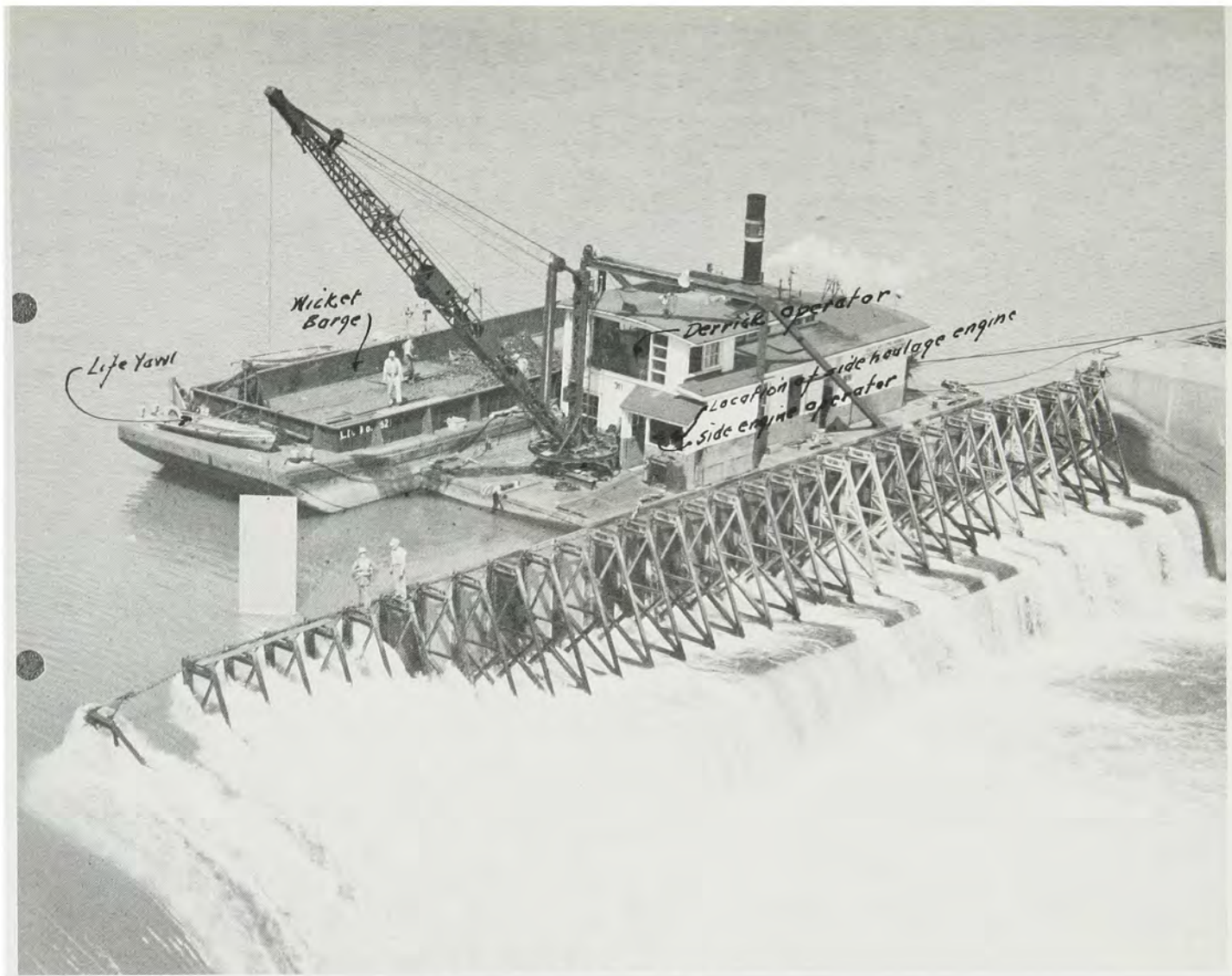
The original canalization project on the Ohio planned fifty-four locks and movable dams, but the elimination of proposed locks and dams numbered 40, 42, and 54 in the Louisville District reduced the number to fifty-one. The construction of fixed dams on the Upper Ohio to replace older structures further reduced the number to forty-six.³

Because the canalization project was constructed over a fifty-year period, 1879-1929, there was not, strictly speaking, a typical lock and dam; each structure had slight design variations, and No. 41 at Louisville differed considerably from other structures of the series. Locks had standard chamber dimensions of 600 by 110 feet, but the amount of lift at each lock varied from 5.6 to 13.4 feet, to afford an eleven-foot depth over lower lock-gate sills. Lock gates were either the Merrill rolling type, or the mitering-gate type. A small turbine on the river wall of the lock and auxiliary power equipment in a nearby operations building furnished power to maneuver the gates. Next to the turbine pit was a navigable pass, varying in width from 600 to 1248 feet, of Chanoine wickets; next to the pass was a Chanoine weir with shorter wickets than the pass; and next to the Chanoine weir were two bear-trap weirs. Bebout wickets were also used in weir sections and some dams had a fixed weir next to the abutment crossriver from the locks.⁴

Operation of the canalization project was analogous to the operation of a railroad division, with the same function of moving traffic through the system in an orderly fashion. Overall supervision was provided by Ohio River Division at Cincinnati, and the river was divided into districts — Pittsburgh, Huntington, Cincinnati (until 1947), and Louisville — and each lock and dam force constituted a subdistrict. In 1924 each lock and dam was operated by eleven men supplemented by temporary personnel. This number was reduced to nine men by 1930, and further reduced as greater efficiency was achieved.⁵

The operation of the project may be il-





Maneuvering Boule Wickets—two views

illustrated by assuming the Ohio at a high-water stage and all dams down, with wickets flat against the foundation on the river bottom and traffic using the open channel through the navigable passes. As the river fell the dam wickets were raised to maintain a slackwater pool before the river stage was less than the nine-foot project depth. Because of lesser flow and greater slope on the Upper Ohio, the dams were frequently raised roughly in order from Pittsburgh to Cairo. Operations were coordinated by telephone at first and later by radio.⁶

Dams were raised by the crew of a maneuver boat, who caught each wicket with a hook attached to a cable and winch, pulled it up and let it settle into place on its prop, and proceeded across the river until all wickets were up and the dam formed. A good crew could raise the navigable-pass section in about three and half hours. Water continued to flow through the spaces between the wickets after the dam was up, but in dry seasons wooden timbers, or "needles," were placed between the wickets to close the spaces and reduce flow from the pool. In very dry seasons, weeds, ashes, and other substances were deposited in the river above the dam to close small gaps between wickets and needles. When the dam was up, all traffic passed through the lock.⁷

Minor river rises were passed out of the pool by lowering the bear-trap weirs, whose valves could be opened or closed by two men in a skiff. If the rise continued, wicket weirs were lowered to release more water, and finally the wickets of the navigable pass were dropped. The crew of the maneuver boat seized the top of the wickets, pulled them upstream to disengage the props, and let the wickets fall naturally to the bottom. A good crew

in good weather could lower the ordinary navigable pass in an hour and a half.⁸

Maneuvering dams was often a difficult and dangerous operation, frequently performed at night in rain, snow, and ice storms when the river was swift and full of drift. Many maneuver boat crewmen, over the years, fell overboard to their deaths. Ice, which made everything slippery — dams became ice-bound at times — was the greatest hazard. The problems with ice in 1934 were long remembered and will serve as an illustration of the hazards of the work.

On the evening of February 8, 1934, the dams were up and a night-time low temperature of 15 degrees was forecast and the dams were left up. But the temperature dropped to -5 degrees, and on the morning of February 9, the order was issued to lower the dams, for pack-ice was closing the locks. Wickets had to be tripped from the downstream side by pushing on the props till the wickets collapsed; it was done under the threat that pack-ice might descend on the boats at any moment. At one dam, a crew tried to lower the wickets from the upstream side, were caught in an ice gorge, and went over the dam. It took three days to get all dams down. The river then dropped and for the first time since the canalization project was completed in 1929 the project depth was unavailable. The dams were raised in freezing weather, and the project depth was reestablished by February 22. Ice conditions again developed, however, and the dams had to be lowered again in a driving blizzard.⁹

Repair and maintenance work was performed, whenever possible, at a time when it would not interfere with navigation. Lock repairs were usually undertaken in the winter when the navigable pass could ordinarily be left open for traf-



Ice Conditions at Dam No. 41—1958

fic because of high-water stages. Repairs to dams were generally accomplished in the summer when the wickets were in raised position, and were often completed by underwater divers.¹⁰

Channel Maintenance

After 1929, channel maintenance, formerly performed as a separate project by the Cincinnati District, was divided among the four Ohio River Districts. Longer wickets were installed at Louisville District structures and the tops of lock walls were raised during the 1930s, with funds provided by the Public Works Administration, to reduce the amount of necessary channel maintenance. Dredging and other channel rectification projects were completed by the Louisville District Engineer fleet until 1955, however, and thereafter by vessels from other Districts.¹¹

Two types of dredges were used in the Louisville District: the dipper, or bucket, type, which dug like a steam shovel, for the removal of solid and compacted materials, and the hydraulic, or pipeline, type for sandy materials which were more readily removable. In 1931 the District operated the pipeline dredges *C. B. Harris*, *H. S. Tabor*, and *Lake Charles*, and the dipper dredges *Watauga* and *Nolin River*. In 1937 the fleet consisted of the dredges *Harris*, *Taber*, *Nolin River*, *Cincinnati*, *Adams*, *Jewett*, and nineteen derrick boats.¹²

The operation, maintenance, and repair of Ohio River locks and dams in the District and the repair of district floating plant at the canal drydocks was the responsibility of the Louisville Substation. The Paducah Substation directed operation of District dredges and floating plant; and the Owensboro Substation directed the operation and maintenance of navigation

structures on the Green River system (which had been directed from a substation at Woodbury, Kentucky — Lock No. 4, Green River — until about 1927). The substations at Paducah and Owensboro were closed in 1947 and their functions transferred to the Louisville Substation, which became known as Louisville Repair Station, and in 1955 the last Louisville District dredge, the *Jewett*, was sold. Channel maintenance on the Lower Ohio was subsequently performed when needed by dredges from the St. Louis District fleet.¹³

Commerce on the Ohio, 1940-1950

The value of navigation on the Ohio River during the Second World War confirmed the foresight of the builders of the canalization project. The Ohio and connecting waterways relieved the overburdened railway system of the necessity of transporting bulky strategic materials — coal, steel, sulphur, chemicals, and petroleum — and, because coastal shipping was vulnerable to submarine attack, petroleum-barging began on a large-scale. Barges transported an amount of petroleum during the war equivalent to seven million rail tankcar loads. Inland waterways also permitted widespread geographic distribution of war-production industry, which otherwise would have further congested coastal areas; and, because coastal shipyards were working at capacity, 4,031 landing craft and small ships were produced at inland shipyards and floated to the sea for movement to combat areas. Ohio Valley shipyards produced about a thousand sea-going vessels, including 585 LSTs, 74 LCTs, 47 tugs, 36 patrol cruisers, 16 mine-layers, and other craft. The draft of these vessels often exceeded project depth on the Ohio, and the Corps resorted again to the creation of "ar-

tificial waves" by manipulating movable dams to permit movement of the vessels to the coast.¹⁴

No noticeable hiatus in the growth of commerce on the Ohio occurred in the postwar years. The average annual increase in tonnage was about 15% and ton-mileage increase was greater. The Ohio River Canalization Project was authorized in 1910 on a projected traffic forecast of thirteen million tons; by 1950 traffic amounted to 48,598,000 tons and a massive traffic jam was developing. Much of this increase in traffic was generated by new steel, aluminum, chemical, and steam-electric plants which located at riverside to take advantage of low-cost waterways transportation and reliable water supply; and their location in the Ohio Valley had a "rippling" effect, attracting secondary industry to the region to use the primary products and power produced at riverside.¹⁵

Navigation Modernization

The Corps began planning during the early 1950s to modernize navigation facilities on the Ohio. Nineteen new navigation structures were planned to supercede the old movable dams and 110-by 600-foot locks. Project designs called for non-navigable dams with low fixed sills, and movable tainter gates — metal gates with long trunnion arms to rotate the gates high enough to clear maximum high water. The consensus of river navigators was that a 110- by 1200-foot lock could handle the largest barge tow which could be operated efficiently on the Ohio, and the new locks were designed with these dimensions. An auxiliary 110- by 600-foot lock was also planned to give additional flexibility and capacity at each structure. Whereas the old locks had an average seven-foot lift, the new locks were de-

signed with lifts ranging from 12 to 37 feet.¹⁶

The modernization project had multiple advantages. The maintenance costs of the old system were rising; the new structures would reduce these costs. Greater dam-height and lock-lift would provide longer slackwater pools, reducing the resistance to barge propulsion met in shallow pools and the number of lockages. The larger lock-chamber dimensions would end the double-lockage necessary when tows exceeded the 600-foot length of the old locks; and the new locks were designed with an improved valve and outlet system which permitted filling in about eight minutes, as compared to eighteen minutes at the old locks.¹⁷

Seven of the nineteen new navigation structures — Markland, McAlpine, Cannelton, Newburgh, Uniontown, Smithland, and Mound City Locks and Dams — were tentatively located in the Louisville District. Construction of the project in the Louisville District proceeded in a general downstream order after approval for the modernization program was extended on March 11, 1953.

The District commenced construction of Markland Locks and Dam, about halfway between Louisville and Cincinnati (to eliminate old Locks and Dams Nos. 35, 36, 37, 38, and 39), on April 25, 1956, and completed the locks in 1959 and the dam in 1963. Noteworthy features of the locks were the positioning of the 1200-foot locks riverward of the auxiliary 600-foot locks to facilitate the entry of large tows; the split filling and emptying system permitting rapid operation; and riverside lock discharge outlets, in contrast to the old system of emptying below the lower lock-gates, to minimize turbulence in the lower-lock entrance. The fixed dam had twelve tainter gates, each 42 feet high by

100 feet long between fifteen-foot wide piers. The tainter gates were raised and lowered with electric hoists mounted atop the piers; and the supporting trunnion arms were designed to permit raising the gates above all floods of record.¹⁸

Construction of the new structure at the Falls of the Ohio, named McAlpine Locks and Dam in honor of William H. McAlpine, became a race against time, for old Lock No. 41 had the economic capacity of passing only nineteen million tons annually; tows were waiting for hours at Lock No. 41 in 1955 before they could be locked through. Widening the old Louisville canal from 200 to a 500-foot width began in 1959 and was completed in 1962. The new 1200-foot lock was completed in 1961; and renovation of old Lock No. 41 was completed in 1965. Because the lock completed by General Weitzel in 1872 was left in place, McAlpine Locks and Dam became the only navigation structure on the Ohio with three locks. McAlpine Dam was commenced in 1961 and completed in 1964, with two tainter-gate sections and 4500 feet of fixed concrete weir. One of the most striking features of McAlpine Dam was the old Boulé and Chanoine wicket sections which were left in upright position and imbedded in the upstream face of the dam.¹⁹

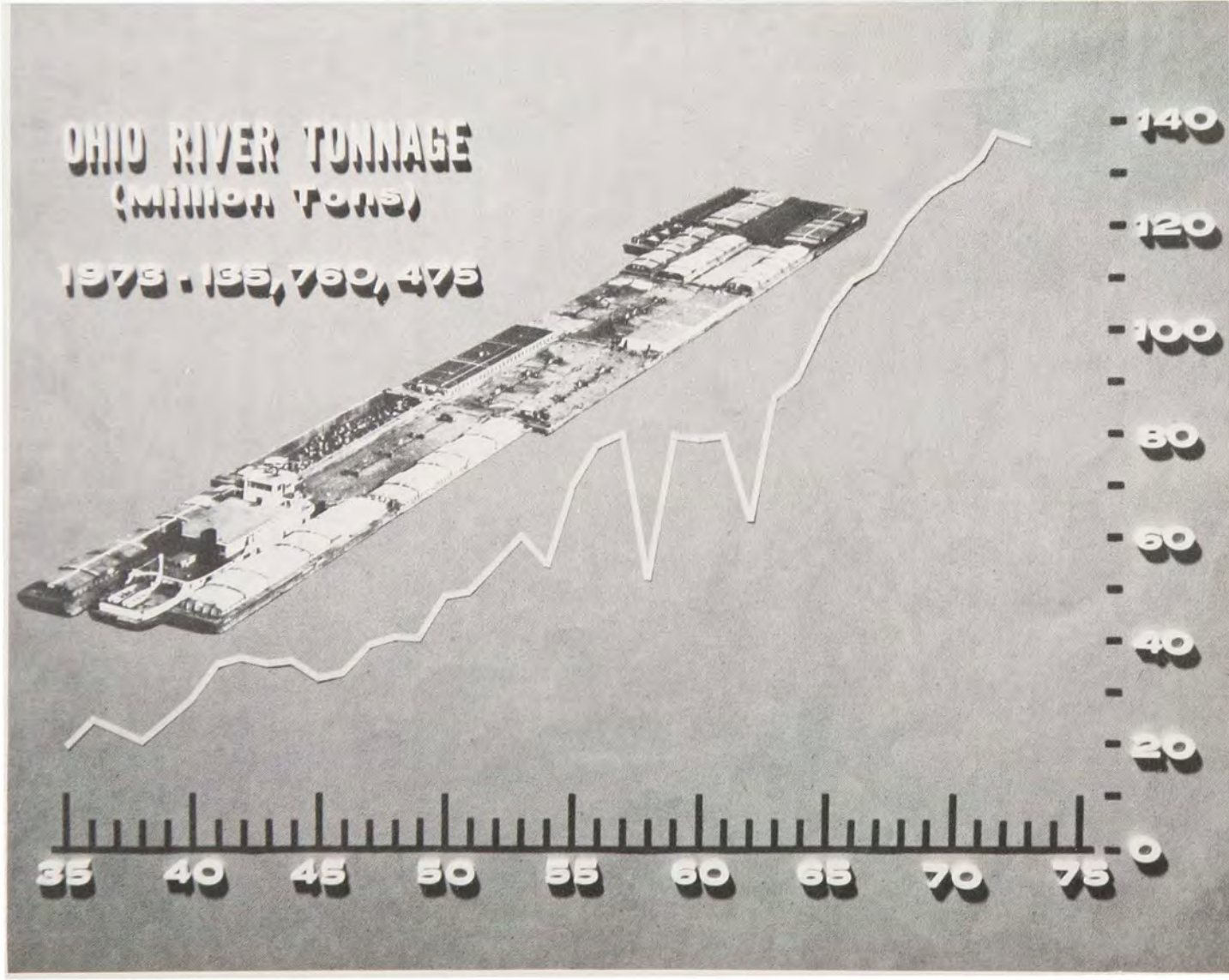
Cannelton, Newburgh, and Uniontown Locks and Dams were at various construction stages in 1975; and completion of all three projects was expected by 1976. Construction of the \$200,000,000 Smithland Locks and Dam project, near the site of Cumberland Dam built by Captain Henry Shreve in the 1830s, began in late 1971, and as a result of an unexpectedly heavy traffic on the Lower Ohio, generated largely by a boom in coal-barging along the Green River and other tributaries, two 1200-foot locks, instead of one 1200- and

one 600-foot lock as at upriver structures, were designed for the Smithland project. Mound City Locks and Dam project was still in the planning stages in 1975, and the greatly increased traffic on the Lower Ohio simply overwhelmed the capacity of old Locks and Dams Nos. 52 and 53. Interim relief for burgeoning traffic was provided at No. 52 (Brookport, Illinois) by construction of a temporary 1200-foot lock on the landward side of the existing lock; and in 1973 planning for a similar stopgap measure at Lock No. 53 (Grand Chain, Illinois) was underway.²⁰

The Runaway Barge Problem

The Engineers in charge of construction of the timber-crib dam across the Falls of the Ohio and the building of Davis Island Dam in the 1870s and 1880s frequently reported that barges, running wild down the river, had injured the structures. The growth of commerce and the completion of the fixed dams of the modernization project led to an apparent increase in this type of accident in the 1960s. In 1967 and in 1972 three serious incidents of this character occurred in the Louisville District.

Fourteen barges broke loose from their mooring above Markland Dam in May, 1967, plummeted down river on a swift current in a fog, and smashed into the dam, wedging in gate openings and wrapping around piers. It was impossible to close seven of the twelve tainter-gates and the pool gradually fell — navigation was suspended on May 25. Floating equipment from Louisville and Pittsburgh Engineer Districts was rushed to the scene and outside aid was acquired to expedite clearing the gates. By a combination of lifting, hauling, flotation, cutting, and dynamiting methods, the barges were removed — the last on May 31. The pool



was rapidly raised and lockage began that afternoon; thirty-one tows were waiting at the time.²¹

Three barge mishaps occurred in the pool above McAlpine Dam during March, 1972. The most serious of the three, the "chlorine barge crisis," began on March 19 when the towboat *J. F. Hunter* grounded on Shippingport Island and lost five barges. Louisville Repair Station personnel secured a sulphuric acid barge which lodged against the inlets of the hydroelectric plant at McAlpine, but another barge carrying 640 tons of liquid chlorine in four steel tanks slammed into Dam Pier No. 2 and lodged halfway through the gate-bay. If a chlorine tank ruptured, it would release a toxic chlorine gas. After a review of alternatives, the decision was made to attempt to stabilize the barge to prevent it going over the dam and to pump the chlorine into another barge.²²

Captain John Beatty was called in as contract salvager with his catamaran rig which had aided in clearing Markland Dam in 1967; and because of the danger to the surrounding community several other federal agencies — Environmental Protection Agency, Office of Emergency Preparedness, and the Coast Guard, which acted as on-the-scene coordinator — were assigned roles in handling the emergency. An empty chlorine barge to receive the transfer moved into place on March 29, and 4400 residents of the Portland area of Louisville near the dam were evacuated as a precautionary measure. On April 1 and 2 the catamaran rig was carefully inched into position over the chlorine barge, sliding cables under the barge hull and winching them up to secure the barge. Once the barge was stabilized, the chlorine was pumped out and removed, and the crisis had passed.²³

Less than a month later, on April 20, a

thirteen-barge tow broke up above McAlpine Dam, and several went over the dam, but public attention centered on another accident at Cannelton Locks and Dam project, where the towboat *Thomas W. Hines*, while preparing to enter the locks with a petroleum tow, lost control and was swept downstream sternmost. The pilot lost his life and a petroleum barge exploded, damaging the Cannelton project and loosing a sheet of flaming petroleum down river.²⁴

Ten barge accidents — collisions, explosions, and sinkings — occurred on the Ohio River from October, 1971, to April, 1972. This type of accident probably cannot be always prevented, but doubtless there are methods of reducing their frequency, and the Army Engineers initiated study of the problem. Congress enacted legislation on July 11, 1972, designed to improve waterways safety by requiring the testing and licensing of towboat pilots and authorizing the Coast Guard to establish traffic-control systems on waterways similar to the system used by aviation.²⁵

Navigation on Tributaries

The United States had acquired several state and private-owned slackwater navigation projects on streams tributary to the Ohio, including the Green and Kentucky River projects, in the late nineteenth century. It will be recalled that the Army Engineers were directed to repair, operate, and extend the projects. Congress also provided funds for the improvement of other streams, such as the Wabash, White, and Tradewater rivers in the Louisville District. Congressional waterways policies of the era were somewhat haphazard, and critics of those policies derided them as the "pork barrel." The reform of "pork barrel" policies began during the early twentieth century — the





The Chlorine Barge lodged on the McAlpine Dam, 1972

Progressive Era — and appropriations for the projects on tributary streams were curtailed. General Harry Taylor, Chief of Engineers, reviewed these developments in 1926:

In connection with the smaller rivers there was formerly a great deal of politics which controlled largely the appropriations and improvements. In 1902 conditions reached such a state that Congress directed that a board, known as the River and Harbor Board, be authorized to pass on all improvements. Since then there has been practically no improvements authorized by Congress that has not been recommended by that Board. About 70% of all the projects reported on by the Board have been reported unfavorably. Since 1920, Congress has adopted the method of making lump sum appropriations instead of itemized appropriations. Formerly, Congress directed where the money should be spent; it is now appropriated as a lump sum available for allotment by the Chief of Engineers, so that if anything is spent on worthless engineering projects, the Chief of Engineers is responsible.²⁶

Few funds, other than those necessary for operation and maintenance of existing projects, were expended on Ohio River tributaries in the Louisville District after 1902. Navigation structures on tributaries were operated as long as commercial traffic used them, but, when the steamboat trade came to an end during the Depression of the 1930s, the Corps began to abandon some projects and allow others to deteriorate because maintenance or replacement costs far exceeded any expected benefits. Commercial navigation on Ohio River tributaries in the Louisville Engineer District was largely intermittent after 1930, but during the 1950s rapid industrial development in the Ohio Valley and the need for coal to furnish power brought renewed interest in commercial navigation on tributary waterways.²⁷

Wabash River Navigation

From 1872 to 1902 Congress appro-

priated \$810,500 for the improvement of navigation on the Wabash — a sum far less than was expended in constructing a single lock and dam on the Ohio River. The Engineers expended these limited funds on removing snags and obstructions, building a few spur dikes and dams closing secondary channels, and constructing a lock and dam at Grand Rapids of the Wabash. By the time Grand Rapids Lock and Dam was completed in 1894, several railroads were serving the transportation needs of the region and the river was in such poor condition above and below the lock that no substantial traffic developed. The Louisville District recommended the construction of a slackwater lock and dam system on the Wabash in 1903 to establish a six-foot navigable depth, chiefly to open coal fields to development, as far upriver as Vincennes, Indiana. But the Board of Engineers for Rivers and Harbors rejected the proposal, commenting that no such project would be advisable until the Ohio River Canalization Project was completed. In 1909 the project for improving navigation on the Wabash was suspended.²⁸

By 1922 commerce using Grand Rapids Lock had dwindled to five tons of mussel shells and twenty-eight tons of unclassified articles; in 1923 traffic shot up to eighty-seven tons. Operation of the disintegrating structure was suspended in 1933 and the property sold to the Boy Scouts of America.²⁹

Support for improving the Wabash for navigation continued, nevertheless, generally in connection with possible use of the Wabash as a section of a proposed waterway linking the Ohio and Wabash valleys with Lakes Michigan and Erie — the possibility which had intrigued George Washington after he had examined Thomas Hutchins' map in 1784. The Wabash River Improvement Association,

for example, urged President Theodore Roosevelt to support such a waterway in 1903, asserting that iron ore and grain from the Great Lakes region would thereby find outlet to the inland rivers and the Gulf of Mexico.³⁰

The National Waterways Commission recommended construction of a barge canal with a fourteen-foot minimum depth from Toledo, Ohio, on Lake Erie across the Upper Wabash Valley to Lake Michigan in 1912; and in 1933 the Louisville District, in the "308 Report" on the Wabash, concluded:

No considerable commerce on the river is to be anticipated unless it is improved as a part of a through waterway to Lake Erie via Fort Wayne and the Maumee River. Such an improvement would require the construction of 31 locks and dams in the river between the mouth and Americus, mile 324, beyond which a canal affords the most suitable form of improvement.³¹

The proposed slackwater project on the Wabash thus became part of a larger project, known as the Cross Wabash Waterway. Proponents of this project asserted that a slackwater project on the Wabash, having at its upper end two canals, one branching to Lake Erie and the other to Lake Michigan, would provide immense benefits. Continued support for such an elaborate waterway system led to congressional authorization of a reconnaissance study in 1967 to determine the feasibility of improving the Wabash for navigation in conjunction with possible canal routes to Lakes Erie and Michigan, with terminals at Toledo, Ohio, Gary, Indiana, and Chicago, Illinois.³²

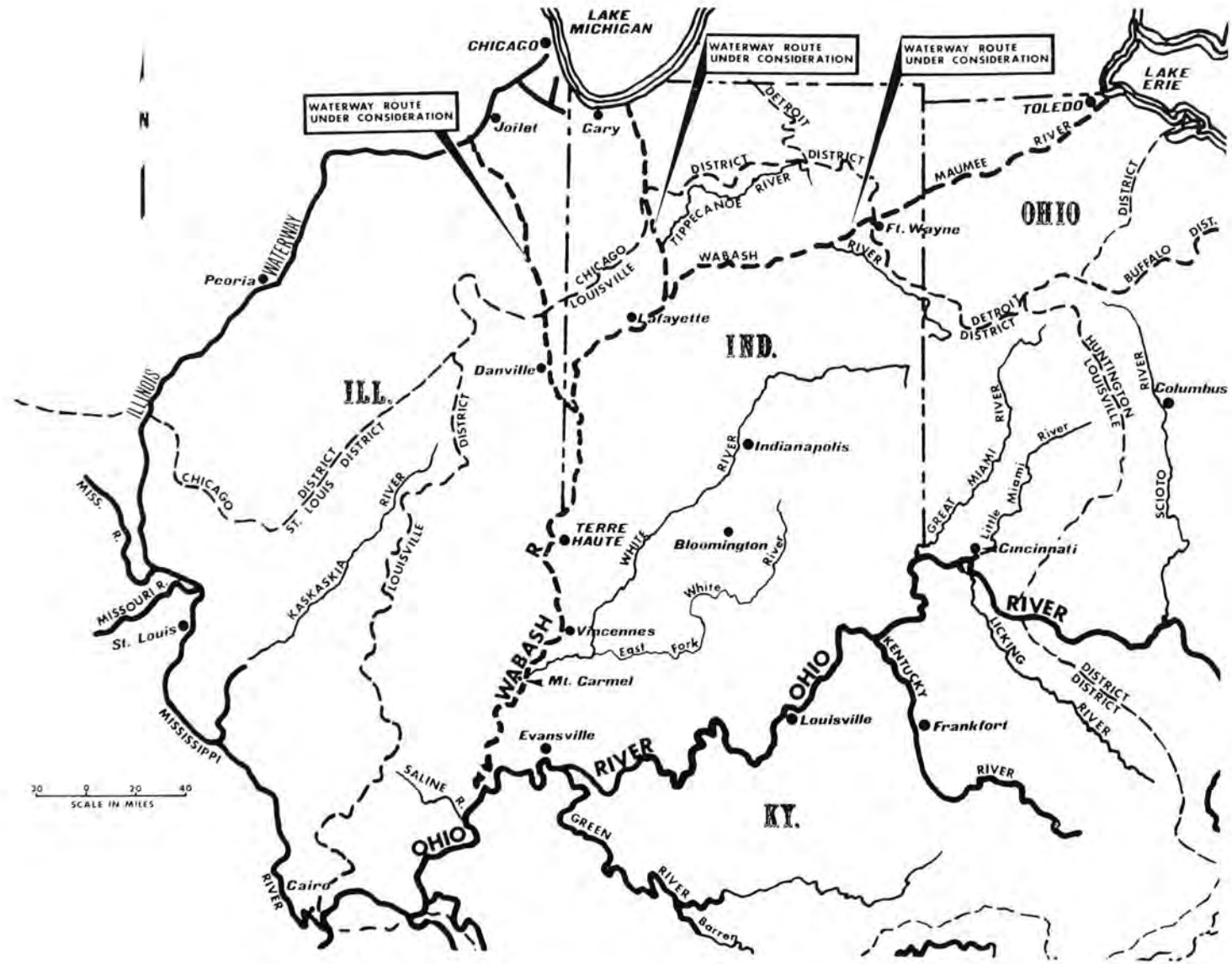
Public hearings on the Cross Wabash Waterway were held in October, 1968, at Terre Haute, Chicago, and Toledo. The states of Illinois and Indiana and many local government entities in the region fully supported the project; and opposi-

tion was expressed by representatives of railroads and of conservationist organizations. The opposition claimed the project would be injurious to an extensive railroad network and would have serious impact on the environment, especially the scenic Maumee River. Opponents claimed the Corps would "contrive" enough benefits to justify construction of the project. Proponents of the waterway declared that it would contribute substantially to the development of the region by providing low-cost transportation for coal, petroleum, and other commodities; they accused the Corps of using the benefit-cost formula only as "a measure to delay development of badly needed improvements."³³

The Louisville District did not recommend a full-scale survey and study of the Cross Wabash Waterway, but it concluded that a study of a navigation project on the Lower Wabash River to serve potential barge traffic carrying coal mined from the immense, high-quality coal reserves of the region would be desirable.³⁴

Green River Navigation

It will be recalled that the Corps of Engineers repaired the state-constructed slackwater system on the Green and Barren rivers after 1888 and extended the system to the Mammoth Cave area by constructing Green River Locks and Dams Nos. 5 and 6, completed in 1899 and 1905 respectively. This was done chiefly to free and facilitate the steamboat packet trade, but a small coal trade also existed. Because of a strike in other coal fields, coal shipment on the Green River rose to 74,765 tons in 1902, but this was an unusually large tonnage. The Louisville District reported in 1913 that reconstruction of the lower locks of the Green River project to permit passage of two coal barges



The Proposed Cross-Wabash Waterway Routes

abreast might soon become necessary "in case of further development of the Green River coal fields," but some forty years elapsed before this became necessary.³⁵

Passenger traffic on the Green River system, which amounted to 11,732 in 1927 and even more previously, had dropped to 2500 by 1931. The last steamboat passenger packet on the Green, the *Evansville*, burned on July 24, 1931, and no effort was made to replace it. The only significant traffic left on the Green was a fleet of small towboats which transported rock asphalt; and this traffic was greatly reduced when the rock asphalt quarries curtailed production during the Depression. Tonnage on the Green, which had been relatively stable at near 600,000 tons per year during the 1920s, dropped to 218,506 tons in 1931. In 1939 tonnage was listed at 164,451 tons, and 962 passengers were reported. The historic log-rafting business on the Green also ceased in 1940. Tonnage, chiefly gasoline and petroleum products, had dwindled to 46,757 tons in 1948.³⁶

It will also be recalled that the first monolithic concrete river lock in the United States had been built on the Rough River, tributary of the Green, in 1896. No significant traffic had ever developed on the Rough; and in 1930 the sole commerce through the lock was 10,039 tons of logs and 240 tons aboard small vessels. Log-rafts were last reported on the Rough in 1940, and in 1941 operation of the lock ceased. The project slowly disintegrated; and in 1959 disposal of the property was authorized.³⁷

It appeared by 1950 that commercial navigation on the Green River system was beyond resurrection; in 1951 the District discontinued operation of Locks Nos. 5 and 6. But Green River navigation was saved by an unprecedented steam-electric

power plant construction boom in the Ohio Basin in the early 1950s. Steam-electric plants were going up at Joppa, Illinois (Electric Energy Incorporated); at Madison, Indiana (Ohio Valley Electric Company); at New Albany, Indiana (Public Service of Indiana); and at other locations. The plant at Madison, Indiana, furnishing electric power to the Atomic Energy Commission, contracted for shipment of two million tons of coal from Green River mines; the New Albany plant contracted for half a million tons; and the other plants would be needing coal. Savings in the cost of shipping coal to the steam-electric plants furnishing power for the Atomic Energy Commission would reduce the cost of the power — a direct savings to the United States.³⁸

In 1953 the Secretary of Army approved a project to rebuild Dam No. 2, Green River, and construct larger locks at Nos. 1 and 2. Congress authorized the widening and deepening of the Green River channel 103 miles from its juncture with the Ohio River. Two new locks, completed in 1956, with chamber dimensions of 600 by 84 feet, replaced the 140- by 36-foot locks built in the 1830s; and the channel was dredged to a width of 200 feet and depth of nine feet. Tonnage, chiefly coal, jumped from 90,000 tons in 1956 to 239,300 tons in 1957. There was no increase in commercial traffic on the upper Green River, however, and when Dam No. 4 washed out in 1965 it was not repaired.³⁹

Tradewater River Navigation

The small appropriations for improving the Tradewater River made by Congress, in spite of protests that the stream should have been "macadamized," during the nineteenth century will be recalled. The Engineers had removed snags and ob-

structions from the stream in the 1880s, and some commercial use of the river had been made. The Louisville Engineer District reviewed the Tradewater project in 1912 and found that the few miles of slackwater on the Tradewater furnished by construction of Lock and Dam No. 50, Ohio River, would adequately serve the region until sufficient traffic developed to warrant additional improvements.⁴⁰

Funds were provided in 1930 to establish a nine-foot channel depth on the lower three miles of the Tradewater, up to the Bell Coal and Navigation Company bargeloading terminal near Caseyville, Kentucky; and in 1931 the dredge *Nolin River* removed 5,200 cubic yards of material, four stumps, and two trees to complete the project. But even the limited coal traffic on the Tradewater dwindled during the Depression years, and the last reported commerce on the river amounted to 882 tons in 1940. Because of the booming coal market in the Ohio Valley, coal-barging on the Tradewater resumed in 1956, amounting to 100,983 tons in 1958. The Louisville District again expended a small sum in clearing the lower three miles of the river of obstructions in 1958.⁴¹

Kentucky River Navigation

The six-foot Kentucky River slackwater project, comprised of fourteen locks and dams, was completed up to the Three Forks at Beattyville, Kentucky, in 1917. From 1884 to 1917, traffic on the Kentucky, consisting principally of log-rafts, other forest products, and coal barged from the Ohio River up to Frankfort, fluctuated from 150,000 to 400,000 tons per year. The "main object" of the Kentucky River project was to establish dependable navigation up to coal fields of the Upper Kentucky Valley, which, it was expected, would barge coal out via the river once the

project was completed.⁴²

The last lock and dam was completed on January 20, 1917. Because of improved design and increased lock-lift, permitting the elimination of three locks and dams planned in the original project, the Kentucky River project was completed at \$689,910.95 less than the original cost estimate of \$4,865,550. The Beattyville Coal Company opened a mine and coal terminal at Procter, Kentucky, in 1917, and shipped 59,500 bushels of coal down to Frankfort. And the Aetna Refining Company began shipping crude oil from a field near Irvine, Kentucky (Lock No. 12), to refineries at Louisville and Evansville on the Ohio River in October, 1918. The oil was transported at first in wooden barges, but losses due to leakage were heavy and the wooden barges were replaced with steel barges, after the steamer *Advance* and three barges, two of which were transporting 7,500 barrels of crude oil, hit a snag above Lock No. 8 on the Kentucky and exploded.⁴³

Crude oil shipments increased from 3,256 tons in 1918 to 136,482 tons in 1925, but pipelines were subsequently completed and by 1931 oil shipments had ceased. The steamboat trade on the Kentucky ended during the Depression — probably the last steamboat on the Kentucky was the *John H. Soell*, which hauled crossties from Beattyville to Madison in 1938. During the same era, gasoline and kerosene in barrels was barged up the Kentucky River as far as Beattyville from the Pure Oil refinery on the Kanawha River, but traffic as a whole continued to diminish and by 1948 commerce was down to 72,614 tons.⁴⁴

When the Louisville Engineer District took over the Kentucky River project from the Cincinnati Engineer District in 1947, its staff reviewed the project and, after



Lock and Dam No. 1—Green River

finding that commercial traffic no longer used the locks above No. 7 (mouth of Dix River), it recommended that operation of Locks Nos. 8 through 14 be suspended. But citizens of the Upper Kentucky Valley entered strong protests, claiming that prospective commerce was voluminous. The District therefore made further operation of the locks contingent upon development of sufficient traffic to warrant the costs of operation and maintenance. The need of a steam-electric plant near Ford, Kentucky (near Lock No. 10), for coal kept the old locks in operation, for limited coal shipment from Beattyville down to the plant was initiated; and by 1958 commerce on the Kentucky had increased to 317,000 tons and 23.5 million ton-miles.⁴⁵

Riverine Renaissance

The improvement of Ohio River tributaries for navigation in the Louisville District ended about 1900, chiefly because of the reform of "pork barrel" waterways policies and the need to concentrate available funds on major through-waterways like the Ohio River. From the turn of the century to about 1950, the nineteenth-century projects on tributaries were operated and maintained but no attempt was made to modernize navigation facilities and commerce slowly diminished. Passenger traffic ended, the log-raft traffic disappeared, and one by one the steamboats left the rivers. By 1950 it appeared that traffic on tributaries in the Louisville District was beyond resurrection. Structures were rapidly deteriorating, maintenance and operation costs were increasing, and the old structures were simply not designed to serve modern marine equipment.

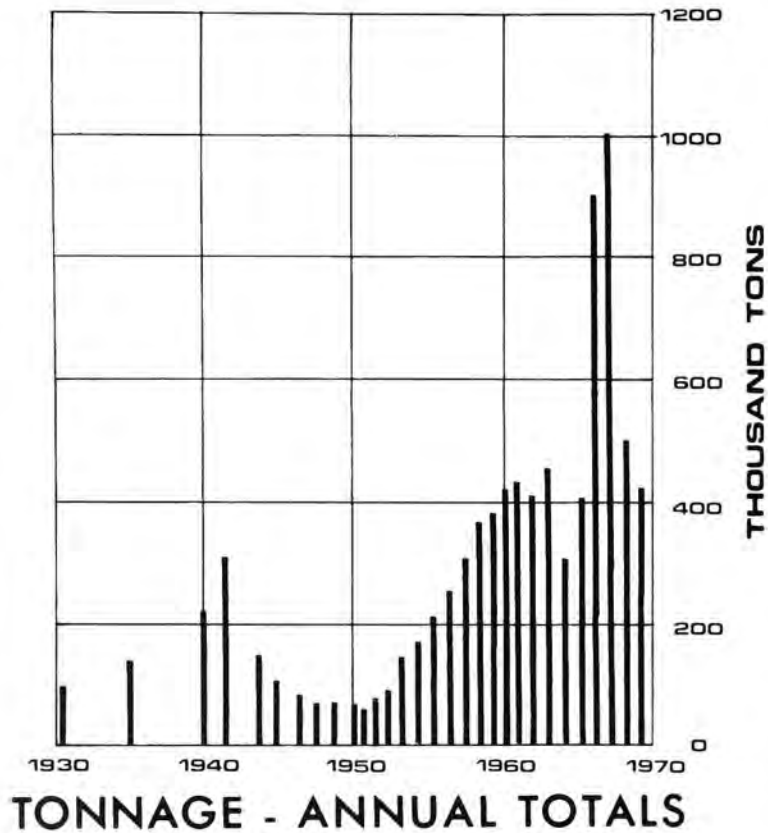
Then, in the early 1950s, in spite of the limitations of the old projects, coal-

barging began on the tributaries to meet the requirements of new steam-electric power-plants. The need for low-cost shipment of coal provided economic justification for improving the lower 103 miles of the Green River system and continued operation of old structures on the Kentucky River project; the demand for cheap transportation of coal was also primarily responsible for a study of the feasibility of restoring navigation on the Lower Wabash River.

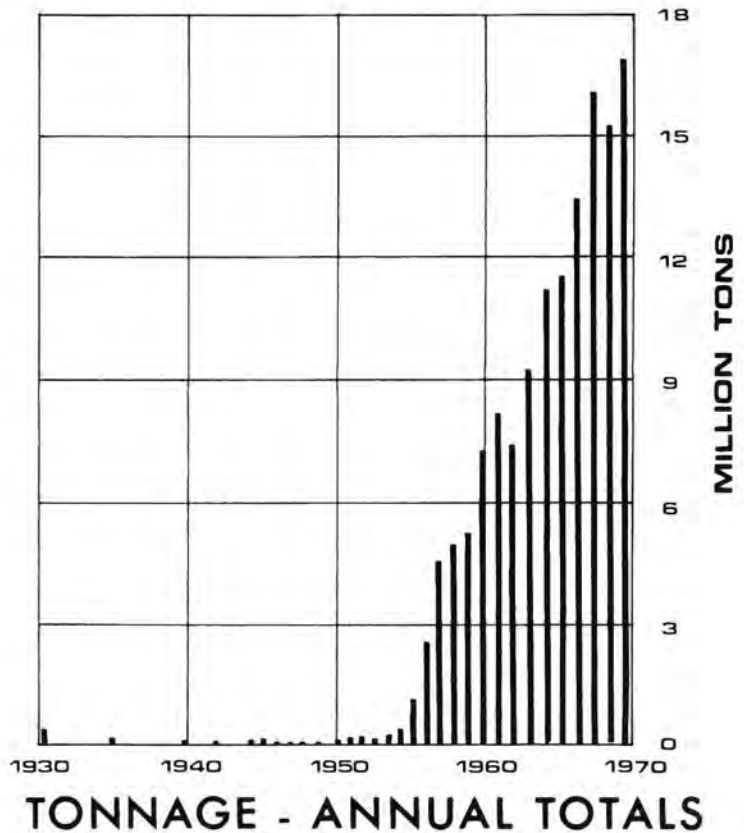
Coal-barging was also an important factor in the renaissance of waterborne commerce on the Ohio River, which resulted in authorization of a navigation modernization project in 1953, but on the Ohio coal was merely one factor among many. Other factors included improved marine design — the development of the twin-propeller diesel-powered towboat, standard welded-steel barges, and specialized craft for handling different commodities — and improved terminal facilities which permitted mechanized barge loading and unloading. But the growth of the Ohio River commerce was much too complex to attribute entirely to the physical improvements provided by hydraulic and marine engineering.⁴⁶

It is difficult to separate the influence of economical waterways transportation on industrial growth from other important elements of the Ohio Valley regional economic structure. Certainly such elements as the abundance of natural resources in the region should be considered; and aspects of the Corps comprehensive water resource development program other than navigation improvement also deserve consideration. But in any analysis, low-cost waterways navigation must figure prominently.

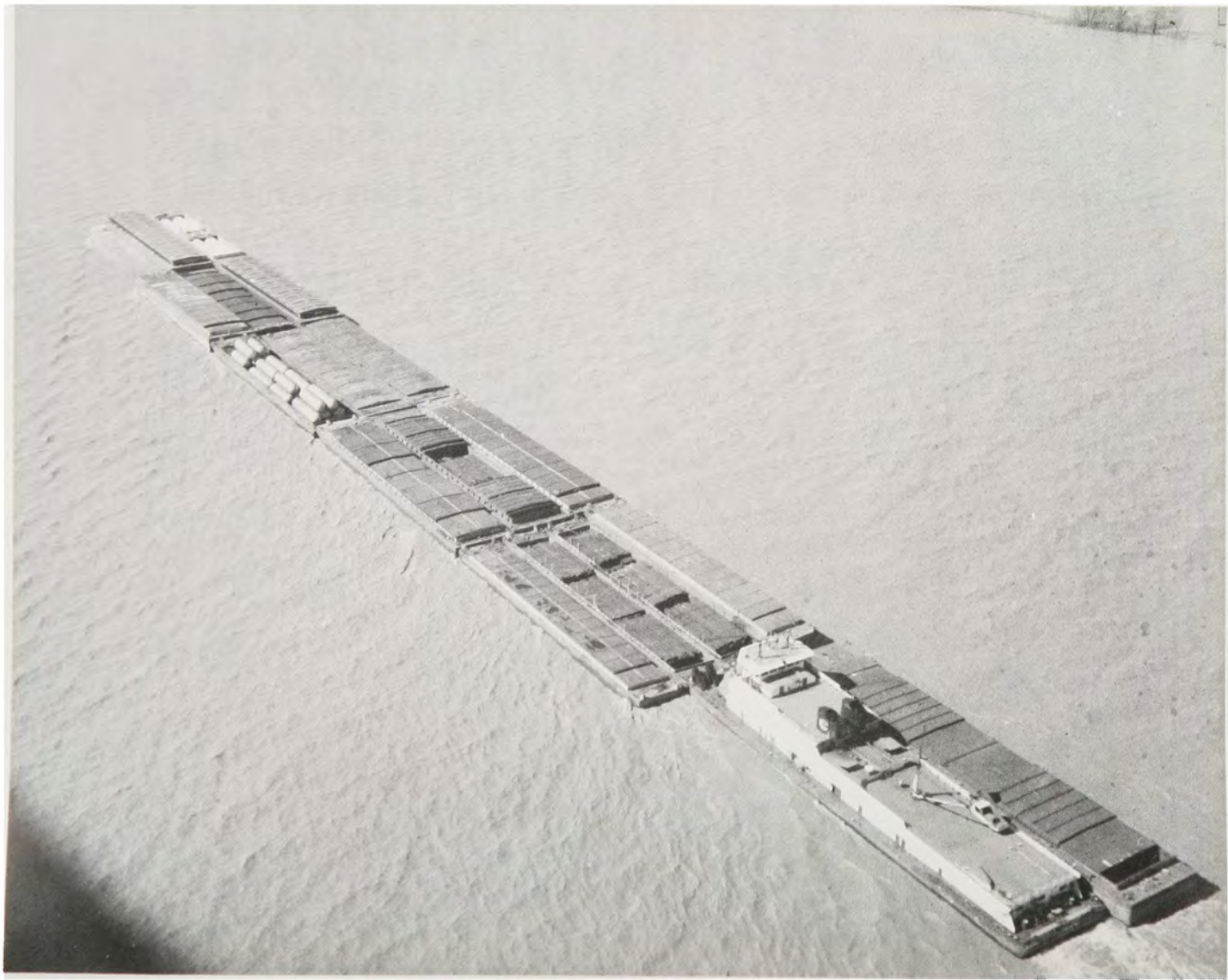
The economic analysis of Ohio Valley industrial development in relation to



KENTUCKY RIVER
FREIGHT
TRAFFIC GROWTH
1930-1970



GREEN AND BARREN RIVERS
FREIGHT
TRAFFIC GROWTH
1930-1970



A Modern Barge Tow



The Steamer Belle of Louisville

waterways transportation generally follows this line of reasoning. Because of dependable and economic navigation on the Ohio River and some of its tributaries, steel plants, chemical factories, petroleum refineries, and similar primary industries located at riverside in the Ohio Valley. These industries, the increasing population of the Ohio Valley, and the activities of the Atomic Energy Commission in the post-1945 era created a growing market for electric power, and steam-electric plants were built at riverside to furnish this power with coal barged in by river. These developments had a "rippling" effect on both waterways transportation and the regional economic structure, for secondary industries for conversion of basic materials into manufactured products located in the Valley where basic materials and cheap power were available. And the aluminum industry also established plants in the Ohio Valley because of economic waterways transportation and electric-power availability. The primary industries and the steam-electric plants generated an enormous traffic in steel, coal, petroleum, and other basic materials, and the new secondary industries stimulated a traffic in commodities which previously had not been transported on the Ohio to any appreciable extent.⁴⁷

The economic boom in the Ohio Valley after the Second World War was therefore a complex interacting development, which had a "snowball" effect on commercial use of waterways. A 1963 review of the situation in the Louisville metropolitan area provided some index to the magnitude of the economic boom.

From 1950 to 1960 the population of Louisville increased 24%; retail sales increased 54%; and tonnage moving to and from the port increased about 80%. In 1964 tonnage handled through the Port of

Louisville was 7,993,878 tons. It was estimated that \$1,800,000 was the amount saved on the 218,000 tons of steel which arrived at the port in 1963. Louisville also received over a million bushels of grain by barge; that is, about 91 bushels for each of the 11,000 workers in the grain-using food and beverage industries of the area. Approximately 526,000,000 gallons of petroleum products arrived at the Port — an amount sufficient to supply all the automobiles in the entire state of Kentucky for a year. Other commodities arriving at Louisville by barge on a large-scale in 1963 were 1,600,000 barrels of fuel oil, 1,700,000 tons of coal, and 202,000 tons of industrial chemicals. Other items included manganese, chrome, lead, and zinc, plus dried milk, soybeans, molasses, paper products, synthetic rubbers, vegetable fibers, and vegetable oils and fats.⁴⁸

Waterborne commerce at the Port of Louisville in 1963 amounted to 64.3 tons for every household in the city; by 1972 total tonnage handled at the Port had climbed to roughly 11 million tons, about 3 million tons more than in 1963. It appeared self-evident that the economic development of the Louisville area was closely tied to waterways commerce.

By 1965 shipments for foreign ports were being loaded directly into ocean-going vessels at the Port of Louisville; and on November 29, 1971, a small Greek freighter, the *Mini Loma*, built in Japan, docked at Louisville with a cargo of agricultural twine from Mexico. The company operating the vessel claimed it saved money by delivering directly to inland ports without transshipment to barges.⁴⁹

The 200 billion ton-miles of freight transported on inland and coastal waterways in 1970 represented an increase of 50% over the amount handled in 1960; an increase generated chiefly by the fact that

charges for waterborne freight were less in 1970 than in 1960, running counter to a national inflationary trend, and were substantially less than for any other transportation method. It was clear in 1973 that a waterways navigation renaissance was in progress. The days when the colorful gingerbread-trimmed steamboat packets

chugged and thrashed their way along the Ohio and its tributaries, trailing clouds of smoke from their high stacks, except for the exciting annual race between the *Delta Queen* and the *Belle of Louisville*, ended decades before 1973, but the advantages of water transportation have remained.

CHAPTER XV: COMPREHENSIVE DEVELOPMENTS, 1937-1973

Under the provisions of the 1936 Flood Control Act and subsequent legislation the Louisville District began providing flood protection for the Lower Ohio Basin in 1937. The first projects in the District were levee and floodwall, or local-protection, projects, a few of which were completed by 1945. In 1947 the scope of the District flood control mission was expanded by transfer of a portion of the Cincinnati Engineer District to Louisville; and about the same time construction of the first flood control reservoir in the District was commenced. Congressional authorization of addition project purposes — such features as recreation, fish and wildlife conservation, water supply, and pollution abatement — after the Second World War transformed the flood control program into a multipurpose, comprehensive program for water resource development; and the program became a major element of the revolutionary metamorphosis in the human environment of the Ohio Valley which occurred between 1945 and 1973.

Floods and Flood Control, 1937-1945

The first flood control structures completed in the Louisville District were high-benefit local-protection projects along the Ohio and Wabash-White rivers. From 1937 to 1945, the District completed planning and partially constructed fifteen local-protection projects around such communities as Indianapolis, Vincennes, Tell City, Jeffersonville, and Evansville, Indiana; Golconda, Brookport, Harrisburg, and Mound City, Illinois; and Paducah, Kentucky. A few projects for the protection of high-value agricultural lands in the Wabash Basin were also completed.¹

Due to the exigencies of military con-

struction in 1942, most flood control projects in the Louisville District were suspended for the duration of the war. The suspension was later regretted, however, for the Ohio River Basin experienced severe flood losses during the war. The Wabash River flood of May, 1943, overtopped most levee projects along the river. Colonel C. L. Hall of ORD described the flood fight on the Wabash:

I started the troops on Monday night May 17, 1943. The rain started on Saturday night, May 15, 1943, and by Monday it became evident we were going to have a superflood, or it looked like it; and the commanding general of the Fifth Service Command very kindly met all my requests for troops. In the meantime, I had sent Engineer Department employees capable of handling the jobs to each of the danger centers. The troops arrived and helped out very greatly. Our principal rescue job was done at West Terre Haute, Ind. We had considerable difficulty there because a lot of the people did not want to move from their homes, and the greatest tact had to be displayed by the troops to persuade them they had better get out before they were drowned.²

A similar flood-fight ensued in March, 1945, on the Ohio River. Projects at Tell City, Indiana, and Golconda, Illinois, were completed in the Louisville District and operated satisfactorily during the flood; and emergency operations were conducted at partially completed projects. A 1747-foot temporary levee was hastily erected in the Jeffersonville-Clarksville levee and floodwall system; similar methods were employed at Evansville, Indiana, and Mound City, Illinois, projects; and pumps were installed and gate-openings sandbagged at other projects. These emergency measures contributed substantially to the estimated \$29,000,000 flood damages prevented by the flood control structures in the Ohio River Basin



Box Construction at Vincennes, Indiana
Flood Emergency Work



Mill Creek Barrier Dam under construction—1945 Flood
Cincinnati, Ohio

during the flood, but damages were still heavy. Twenty-four people lost their lives; 188 war-production plants were shut down and production curtailed at another 93; and the vital work at Army Ordnance plants was disrupted by materials shortages and flood-related absenteeism.³

In 1946, the president of the Ohio Valley Improvement Association described the flood disaster of 1945 to the House Committee on Flood Control and presented a resolution of the OVIA which read, in part:

The Ohio Valley has now proved that it is capable of constituting the Citadel of Defense of the Nation in wartime. It is imperative that the industry, communications, and community organization of this region be protected effectively against the suspension of production, disruption of supply, and the breakdown of life and order which recurrently threaten so long as floods are permitted to continue a menace.⁴

Local Protection Projects

With the cessation of hostilities in 1945, work resumed in the Louisville District on local-protection projects. This type of project consisted of earth-levee construction, drainage systems, concrete floodwalls, pumping plants, closure structures, channel rectifications to increase flood-carrying capacity, and many complex combinations thereof. These projects were ordinarily designed to protect a limited area, usually an urban and industrial concentration, against the maximum flood of record. A few projects in the Wabash Basin for the protection of agricultural properties, however, were designed to protect only against "cropping season" floods. Earth-embankment levees, with openings for roads and railroads closed with movable gates, panels, and sandbags during flood alerts, were the most common type of local-protection project. Concrete floodwalls were often substituted,

however, where land acquisition costs were exorbitant. Sewerage discharge and interior runoff within levee systems were disposed of by the construction of pumping plants to pump over the levees during high-water periods. Pumping plants in the Louisville District varied in size from small pumps in manholes to the very large plants at Cincinnati (Mill Creek Plant) and Louisville (Beargrass Creek Plant).⁵

The benefits of local-protection projects, as the name implied, accrued principally to the area protected; and federal law provided that the communities receiving the benefits cooperate in the project by providing lands, easements, and rights-of-way, paying damages resulting from construction, and maintaining and operating the project after completion. One problem experienced in the Louisville District, as elsewhere, was the reluctance of communities to tax themselves to fund local cooperation requirements. On occasion, Congress authorized projects but local interests did not meet cooperation requirements until after serious flood damages had awakened the entire community to the need for the project. And in some cases communities failed voluntarily to meet their obligations after the project was completed. Congress provided in the 1970 Flood Control Act that local-protection projects should not be constructed until nonfederal agencies signed legal contracts binding them to meet their full obligations.⁶

By 1956 the Louisville District had completed 43 local-protection projects and had 13 under construction. Many more were completed by 1975. Most of these projects are quite similar in construction, though each was unique because of variations in the flood problem at each locality. A few, however, were of special interest.

The first bond issue for the immense

local-protection project at Louisville, Kentucky, was approved by a referendum on November 5, 1940. Original project plans provided for over eight miles of earth levees and three miles of concrete floodwalls, plus fourteen pumping plants to protect the Falls City from floods the magnitude of that of 1937. Construction commenced in 1947 and was completed in 1956, with later additions and modifications completed as experience and growth of the city proved necessary. In 1972 citizens of Jefferson County passed a bond issue to meet local cooperation requirements for a project to protect a rapidly growing section of Jefferson County adjacent to Louisville.⁷

The Cincinnati local-protection project, which became the responsibility of Louisville District in 1947, had, in addition to the usual levees and floodwalls, a barrier dam across Mill Creek to prevent Ohio River floodwaters from inundating the heavily industrialized Mill Creek Valley section. At times of flood in the Ohio, the barrier dam was closed and the entire flow of Mill Creek pumped over the protective structures into the Ohio. The project was about 85% complete when Louisville acquired it in 1947. It was completed, at costs of \$9,973,000, just before the flood of 1948, and in its first year of operation prevented an estimated \$4,700,000 in flood damages — nearly half the construction costs.⁸

The Newport, Kentucky, project, across the Ohio from Cincinnati at the mouth of the Licking River, originally called for the construction of an 8000-foot levee and a 4000-foot concrete floodwall. Because of unstable foundation conditions along the Licking River front at Newport, the District adopted the somewhat unusual method of constructing a floodwall of cellular piling; that is, interconnected steel-

piling cells filled with sand and gravel similar to cofferdams frequently used in constructing navigation projects on the Ohio.⁹

Hawesville (Hancock County), Kentucky, on the Ohio about thirty miles northeast of Owensboro, was hit hard by floods in 1937, 1945, and 1948, but Corps studies indicated that construction of an adequate local-protection project would require local contributions of \$28,000. The population of Hawesville was less than a thousand, and assessed property valuation was less than \$300,000. A bond issue for the project was not negotiable so in 1946 the community began "passing the hat." With only a single outside contribution of \$2,000, the town collected the necessary sum in four years — with an average donation of thirty dollars per resident — and Hawesville had its floodwall by 1953.¹⁰

Reservoir Projects

When the Cincinnati Engineer District was deactivated on January 1, 1947, and its geographic area divided between Louisville and Huntington Engineer Districts, the Louisville District boundary was adjusted to include Locks and Dams Nos. 34 to 39 on the Ohio, the fourteen locks and dams on the Kentucky River, local flood protection projects under construction at Cincinnati, Ohio; Lawrenceburg, Indiana; and Newport and Covington, Kentucky, and others in planning stages. No reservoirs were under construction at the time of transfer, but the Cincinnati District was studying authorized projects in the Licking River (of Kentucky) Basin, the Kentucky River Basin, the Miami and Little Miami River Basins, and Mill Creek Reservoir in Hamilton County near Cincinnati.¹¹

Though neither the Cincinnati nor Louisville Districts had reservoir projects



Tell City, Indiana without floodwall in 1937



Tell City protected from 1945 Flood by floodwall

under construction as of January 1, 1947, several proposed reservoirs were in final planning stages. During the following quarter-century, the Louisville District completed a major reservoir project on the average of one every two years. By 1972 the Louisville District had completed twelve reservoirs for flood control and allied purposes, had nine under construction, and several others in active planning stages; and by that date so many project features in addition to flood control had been authorized that the projects were better described as multiple purpose, rather than flood control, reservoirs.

Wabash Basin Reservoirs

The first reservoir planned in the Wabash Basin was Shoals Reservoir at a proposed damsite near Shoals, Indiana, on East Fork of the White River. The project was authorized by the Flood Control Act of 1938, and the Flood Control Act of 1941 included hydroelectric power production generation as a project feature. The Louisville District reviewed plans for the Wabash Basin in 1944 and found that two additional reservoirs — Spencer and Wolf Creek projects — would also be economically feasible. But at public hearings on the three projects in 1945 great opposition to the proposed Shoals, Spencer, and Wolf Creek projects was expressed. The Governors of Illinois and Indiana, in effect, vetoed the proposed projects. Governor Ralph F. Gates of Indiana explained:

We believe that it would be advisable to start the reservoir program within our State with reservoirs of smaller size. By that we mean smaller areas of inundation that would not remove from some of our county-tax duplicates the major portion of the properties subject to taxes to support our schools and county governments. It has been noted by the Indiana Flood Control commission that one reservoir stands out above all the rest in its economic

possibilities. This reservoir is known as the Cagles Mill Reservoir.¹²

The Board of Engineers for Rivers and Harbors and the Chief of Engineers concurred with the Governors, and the three large reservoirs were therefore dropped from Wabash Basin plans. Construction of Cagles Mill Reservoir project, the first in the Louisville District, was undertaken as recommended; it was to be a sort of proving ground where Hoosier doubts and fears could be allayed.¹³

Cagles Mill Dam and Lake, on Mill Creek, a tributary of the Eel River, about midway between Terre Haute and Indianapolis, Indiana, was designed as a multipurpose project for flood control and recreation. The first tract of land was acquired in February, 1948; construction was begun in July, 1948; and the project was completed in June, 1953. The dam, like most subsequent projects of this type in the Louisville District, was an earth and rock-fill embankment, with a maximum height of 150 feet and length of 900 feet. The normal pool for recreation had an area of 1400 acres, with room for storage of 201,000 acre-feet of flood water — equivalent to 12.8 inches of runoff from the 295 square-mile drainage area. Recreation facilities were developed by the State of Indiana. Cagles Mill was drained in 1971, after nearly twenty years of operation, and about a million pounds of rough fish were removed, while game fish were saved for restocking purposes. The Louisville District carefully inspected the condition of the project at that time and found that siltation was minimal and the dam outlet structure was in excellent condition.¹⁴

Mansfield Dam and Lake, a few miles northwest of Cagles Mill on Raccoon Creek, tributary of the Wabash, was the second reservoir completed in the Wabash Basin. Also built for flood control and rec-



Cagles Mill Lake, Indiana



Cataract Falls at Cagles Mill Lake, Indiana

reation, with the state managing the recreational facilities, it was similar in many respects to the Cagles Mill project.¹⁵

The second series of reservoir projects in the Wabash Basin was authorized by the Flood Control Act of 1958. This authorization marked the end to the original hesitant support of the State of Indiana for reservoir projects, for to obtain approval for the projects Indiana had to agree to pay portions of the costs of construction. Construction of Monroe, Huntington, Salamonie, and Mississinewa reservoirs was authorized, provided the state paid construction costs allocated to low-flow regulation features at Monroe and land-enhancement values at the other three. Monroe Lake was built on a tributary of the East Fork of the White River in south-central Indiana, and the other three, often called the "Lakes of the Wabash" because of their high recreation value, were built in the Upper Wabash Basin to operate as a unit for flood control. All four projects were essentially complete by 1970.¹⁶

The third series of Wabash Basin projects was authorized by the 1965 and 1968 Flood Control acts, which provided that local interests pay a portion of construction costs allocable to recreation and conservation and administer the recreation-conservation program at each project. This series included Louisville, Helm, and Lincoln Lakes in Illinois, and Downeyville, Big Blue, Clifty Creek, Lafayette, Big Walnut, Big Pine, and Patoka lakes in Indiana. All were in various planning, land acquisition, and construction phases in 1975.¹⁷

Green River Reservoirs

Seven reservoir projects for flood control were recommended for the Green River Basin in the "308 Report" of 1933, and after the 1937 flood, during which as

much as 25 inches of rain fell at several points in the Green Valley, the Louisville District also recommended construction of a large reservoir project — the Mining City, or Rochester, Dam — located just above Lock No. 3, Green River, to control the great water volume generated by storms the magnitude of that of 1937. The Mining City reservoir was opposed because of its possible effects on Mammoth Cave, and the other proposed projects were opposed by residents of the areas which would be inundated by the lakes. Opposition was so strong for several years that flood control plans for the Green River Basin could not be implemented.¹⁸

But in 1950 an incident occurred which galvanized support for flood control in the Green Valley. A group of engineers representing private power companies (Electric Energy Incorporated) inspected sites in the Ohio Valley in late 1950 for construction of a multi-million dollar steam-electric plant; and one of the sites considered was located in the Green River Valley near Paradise, Kentucky. The engineers rejected the Green River site because of its flood problem and its lack of adequate navigation facilities, selecting instead a site on the Ohio River near Joppa, Illinois (Mile 952). Partially as a result of this incident, the Green River Valley Citizens League was organized in 1951 to promote the economic development of the Green River region; and at its first policy meeting the League resolved that flood control was vital to the future development of the region, that the Mining City reservoir project be held in abeyance, and that four other reservoirs — on Nolin, Rough, and Barren rivers and at damsite No. 2, Green River, above Mammoth Cave — be constructed at an early date.¹⁹

The four reservoir projects for which the

Citizens League organized support were completed and in operation by 1975, but their construction was accomplished only after extensive political controversy, which was a classic example of the "upstream versus downstream" conflict often met by the Corps and other water-resource development agencies. The Citizens League represented those interests, chiefly from downstream, which needed flood protection and desired the economic development which reservoir projects frequently stimulate. Opposition to the projects was strongest among those whose homes were located in the reservoir areas — the "upstream" interests.²⁰

When the Barren River reservoir project was under consideration, the Superintendent of Schools of Barren County eloquently presented the case for the "upstream" interests, saying:

You take our birthright for a poor mess of pottage that comes in a fisherman's paradise. It seems to me the Lord gave us Wisconsin and Minnesota as our lake country, and planned Kentucky as a State for agricultural pursuits. Should we cover this rich land, we would be guilty of burying our talent without cause. Those lower valleys of our county, and the rich land of Allen and Monroe counties are not wild and desolate. . . . Can you cut a man from his people, his cemetery, or his church and call such an act a move for the general welfare. Take these people and their homes — a man's home is his, and a castle it is, though it might not value a thousand dollars. This immeasurable and intangible American tradition cannot be treated lightly.²¹

The views of the "downstream" interests were reflected in an editorial in the Louisville *Courier-Journal* complimenting the work of the Green River Valley Citizens League. It read in part:

These dams on the Green, Barren, Nolin and Rough Rivers will eventually free this part of the State from floods, make the Green navigable by major barges and provide a year-around supply of industrial water that will make possible the industrial development of the region. For the past 15 years the towns along the Green River Valley have

been losing population, jobs and income, though the hills along the river are rich with some of the world's largest reserves of coal. The river-development plan will help reverse this economic trend.²²

Salt River Reservoirs

The Salt River, which joins the Ohio a few miles below Louisville, has all the problems of larger rivers in microcosm. It was famous in the nineteenth century for its navigational difficulties — "up Salt Creek without a paddle" — and its floods, which reportedly rose fast enough "to catch a squirrel running up a tree." Salt River navigation was never improved by the Corps; however, the Louisville District planned projects to reduce the flood problem. Nevertheless, though flood damages in the Salt Basin averaged 1.7 million dollars annually, the only flood protection completed in the Basin in 1973 was a floodwall at Taylorsville, Kentucky.²³

The Louisville District planned three reservoirs in the Salt River Basin for flood control and other benefits (recreation was important because of the proximity of the projects to the Louisville metropolitan area). Proposed sites were Taylorsville Lake on the main stem of the Salt, Camp Ground Lake on Beech Fork, and Howardstown Lake on Rolling Fork. The Taylorsville reservoir was approved by Congress in 1967 and was in preconstruction stages in 1973. Congress also approved Camp Ground Lake in 1972, but the bill authorizing the project was vetoed by the President.²⁴

The controversial Howardstown Lake project was not favorably received at public hearings in 1967. Colonel John T. Rhett, Louisville District Engineer, said, "It appeared that local people didn't want it, and it's not our business to go around building dams where people don't want

them." But repeated flooding brought renewed support for the project in 1971, when its proponents launched a public campaign on behalf of the recreational and economic development expected to accompany construction of the project. On the other hand, a citizen of Howardstown said:

The purpose of all this commotion was to take from people their farmland, or livelihood, their homes and church in order to create recreation for the boat and liquor industries and their users.

It seems they would rather create a Sodom and Gomorrah than to let mankind and its habitat survive in this area.²⁵

Kentucky River Reservoirs

The "upstream-downstream" conflict was also evident when the Louisville District inherited the Kentucky River Basin projects from the Cincinnati District in 1947. The "308 Report" on the Kentucky River recommended construction of three reservoirs — Buckhorn on Middle Fork, Booneville on South Fork, and Jessamine Creek on the main stream. Of these three, only Buckhorn Lake, completed in 1960, was in operation in 1975. Jessamine Creek, the mainstream reservoir, because of the large area it would inundate and the number of historic sites it would cover, had great opposition and was deleted from project planning for the Kentucky Basin.²⁶

Booneville Lake on South Fork was still being vehemently debated in 1973, and was a particularly divisive subject in Owsley and Clay County, Kentucky, where the reservoir would be located. One Owsley countian said the residents of the region were satisfied with the way things were and chiefly wanted to be let alone; another declared that Owsley County had the lowest per-capita income in the United States and badly needed the economic opportunities the project would provide.²⁷

Disaster struck the Kentucky Basin in January, 1957, when a flood caused damages amounting to \$11.7 million. President Dwight D. Eisenhower declared the region a "major disaster area," and the Corps moved in, established emergency field offices at Hyden, Hazard, Pikeville, and Manchester, Kentucky, and performed repair and rehabilitation work. In the aftermath of the flood, the Louisville District reviewed flood control plans for the Kentucky Basin and recommended construction of three additional reservoirs on the Kentucky River tributaries Eagle Creek, Red River, and Carr Fork. Senator Thruston B. Morton of Kentucky commented:

Two of the reservoirs, Carr Fork and Red River, are located in regions of Kentucky where economic conditions are depressed. Creation of reservoirs will provide the potential for recreation and tourism and the basis for self-sustaining local endeavor. There is also a great interest in the impoundments as a source of water for municipal and industrial uses.²⁸

The Louisville District had Carr Fork reservoir project under construction in 1973 and was preparing detailed plans and environmental impact statements on the other two projects.

Licking River Reservoirs

Falmouth and Cave Run reservoirs on the Licking River of Kentucky were among the first fourteen reservoirs authorized for the Ohio River Basin in 1936, but their construction had not been commenced when the Licking Basin was transferred from Cincinnati to Louisville Engineer District in 1947. Both reservoirs were quite large; land acquisition costs were high; and the usual upstream-downstream conflict developed over their advisability. Citizens of the lower Licking Basin, especially in the Cincinnati met-



The Cave Run Emergency—1971

ropolitan area, strongly favored the projects; and citizens of the region where relocation would be necessary just as strongly opposed.²⁹

The Cave Run reservoir was finally funded in 1962 and construction began in 1965, but completion of the project was delayed by several developments, notably the flood of July, 1971, which nearly overtopped a temporary diversion dam at the project site.

Drenching thunderstorms in the Upper Licking Basin on July 17-19, 1971, created a near-record flood situation; and a diversion dam, designed to divert the total flow of the Licking River through outlet works while construction of Cave Run Dam was in progress, began impounding floodwaters. That is, the volume of water behind the diversion dam increased faster than the outlet works could pass and threatened to pour over the top of the diversion dam. Rumors circulated that the dam was failing and the flood running wild down the river. The area below the dam was evacuated as a precautionary measure, and emergency work was initiated to raise the temporary dam, sandbag the top, and build a spillway. The flood crested at the damsite on July 21 nearly one and a half feet above the design height of the diversion dam. Increasing the crest-height of the temporary dam by three feet not only prevented extensive damage at the construction site, but also prevented an estimated \$412,000 in flood damages.³⁰

It appeared in 1972 that the Falmouth reservoir project, which had been authorized in 1936, would finally be constructed. Proponents of the project obtained funding approval from Congress, and though President Richard M. Nixon vetoed several flood control project bills in 1972 he approved the Falmouth

project.³¹

Reservoirs in the Whitewater and Miami Basins

Three streams, with basins lying largely in southwestern Ohio, have their confluence with the Ohio River at and near Cincinnati. The Little Miami River joins the Ohio just above Cincinnati; Mill Creek runs through the "Queen City;" and the Miami River, the largest of the three, enters the Ohio below Cincinnati at the Ohio-Indiana state line. The Whitewater River, whose basin lies principally in Indiana, joins the Miami River just above its confluence with the Ohio. Responsibility for water resource development in these basins was also transferred to Louisville District in 1947.

Mill Creek has one reservoir, known as West Fork of Mill Creek Lake, in Hamilton County just north of Cincinnati. The highly industrialized Mill Creek Valley suffered heavy losses during the floods of 1937 and 1945; it was protected from Ohio River floods by construction of a barrier dam across the mouth of Mill Creek, and from most headwater floods on Mill Creek by construction of West Fork Lake. West Fork Lake, commenced in 1949 and completed in 1952, was the second reservoir project completed in the present Louisville District. Recreation features were also an important part of the project, because nearby Cincinnati, and Hamilton County partially reimbursed recreational provision costs and undertook the management of recreation facilities.³²

The Miami Conservancy District provided flood protection on the mainstream of the Miami River after the 1913 flood disaster by construction of five detention reservoirs and related channel improvements. A Corps reservoir project — Clarence J. Brown Reservoir — was au-

thorized in 1962 for construction on Buck Creek, which joins Mad River, tributary of the Miami, above Huffman dam (an MCD project). Springfield and Clark County, Ohio, were above the flood protection provided by the Miami Conservancy District, and Clarence J. Brown Reservoir, nearing completion in 1973, was designed to protect Springfield and the Mad River Basin above Huffman Dam.³³

The 1938 Flood Control Act authorized two reservoirs on the Whitewater River, a tributary of the Miami, which flows from eastern Indiana to join the Miami in the extreme southwestern corner of Ohio. Brookville Reservoir, on East Fork of the Whitewater, was under construction and nearing completion in 1973, while the proposed Metamora reservoir project on the Whitewater was deferred for restudy.³⁴

The Louisville District had two reservoir projects under construction in the Little Miami Basin east and northeast of Cincinnati in 1973. Caesar Creek and East Fork reservoirs, originally authorized for flood control alone in 1938, were multipurpose projects by the time construction began in the early 1970s. Project designs included provisions for recreation, fish and wildlife conservation, and storage for water supply and water quality control in addition to flood control.³⁵

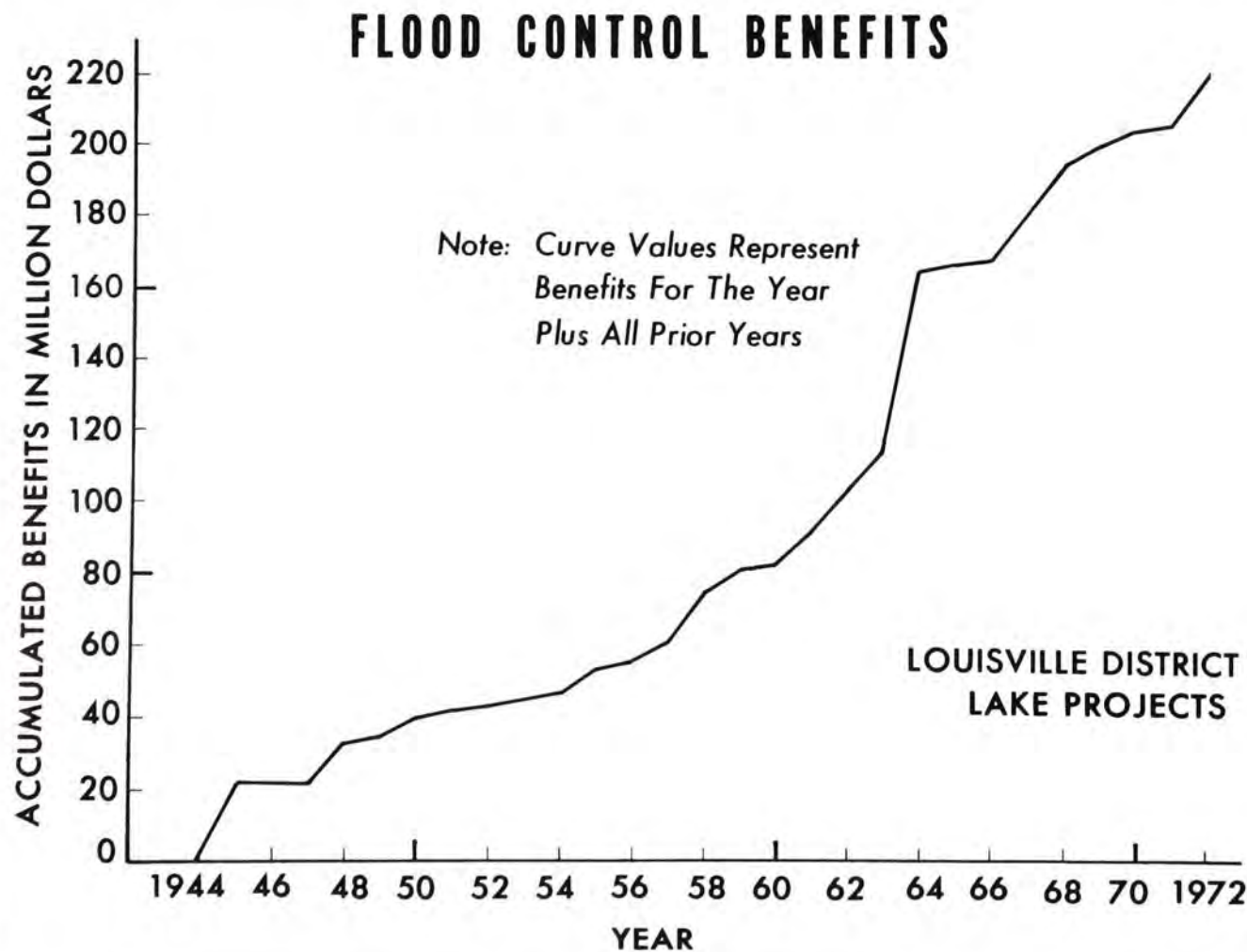
District Flood Control Construction Review

During the first decade of flood control construction, 1937-1947, the Louisville District built high-benefit, quick-result, local flood protection projects, involving levees, floodwalls, pumping systems, and channel rectifications, to protect urban and high-value agricultural lands. These projects were designed as integral components of the Ohio River Flood Control

Plan, which provided a flexible outline for the achievement of flood protection through the completion of local protection projects, especially on the banks of the Ohio, and reservoirs on tributaries. Construction of local-protection projects was initiated first because they provided quick protection and because flood damages had been so heavy at riverside communities that they were willing to meet their local-cooperation requirements. But reservoir construction was delayed, at first because of hiatus necessitated by the scope of the military mission during the Second World War and then by the "upstream versus downstream" conflict.

Public and political opposition to the very large reservoirs — Jessamine Creek on the Kentucky River, Mining City on the Green River, and Falmouth on the Licking River — were so intense that congressional approval did not appear likely for many years. In the meantime, the District devoted increasing attention to smaller reservoirs in upper tributary valleys where sufficient support for authorization and funding existed and which could achieve a substantial measure of flood control if constructed in large numbers.

Cagles Mill Lake in Indiana and West Fork of Mill Creek Lake in Hamilton County, Ohio, commenced in 1948 and 1949 respectively, were the first reservoir projects completed in the Louisville District. These, and similar projects in other Engineer Districts, demonstrated that multipurpose projects could provide substantial benefits and stimulate economic development in the immediate reservoir area, as well as reductions in flood damages in downstream areas. During the 1950s the public and political opposition of "upstream" interests to reservoir projects began to break down as the advantages of multipurpose projects, as opposed



to single-purpose flood control reservoirs, was increasingly recognized. During the 1960s, reservoir projects were authorized and placed under construction in the Louisville District, as elsewhere in the nation, in steadily increasing numbers. By 1973 the Louisville District had completed twelve reservoir projects, was constructing nine, and had more than a dozen in planning stages.

Multipurpose Project Features

The ideal flood control reservoir would probably be similar to the single-purpose projects constructed in the Miami River Basin after the flood of 1913; that is, reservoirs which are empty of water until a flood situation develops, with their entire capacity available for flood water storage. But, as General Hiram M. Chittenden and other engineers observed early in the twentieth century, reservoir project benefits may be multiplied by the provision of water storage for other purposes, such as recreation and water supply. Multipurpose projects can require higher dams and larger reservoir areas, may permanently inundate more land and require more population relocation than single-purpose projects for flood control. On the other hand, multipurpose project benefits may be so high that upstream and well as downstream interests will support the projects, even to the extent of participating, both financially and otherwise, in the development and management of such project features as recreation, fish and wildlife conservation, and water supply. It therefore appeared that the implementation of flood control plans for the Ohio River Basin in the Louisville District was made politically feasible by the expansion of the original flood control program of 1937 into the comprehensive, multipurpose program of 1973. A review of the

overall history of some of the project features added to flood control after 1937 will provide some index to their importance.

Recreation

The Flood Control Act of 1944 authorized the Corps of Engineers to develop recreational facilities at its water resource development projects, and such facilities were first constructed in the Louisville District at navigation locks and dams. Most locks and dams had small, beautifully-kept reservations, with green lawns, shade trees and gardens. Fishing and picnicking near the locks and dams, and watching boats lock through became surprisingly popular during the 1940s. During the summer of 1947, for example, an average of 3,650 people visited the locks in the Louisville District each Sunday. The District initiated a program to provide minimum recreational facilities at the lock reservations about 1946. Sites with shade trees and a view of the river were selected; the lock forces built picnic tables with surplus materials and installed them; and fireplaces, drinking water, and sanitary facilities were added as seemed appropriate.³⁶

Because the first reservoirs in the Louisville District were not constructed until after 1944, the District was able to provide recreational features at its first reservoirs; and public use of recreational opportunities was unexpectedly heavy. The growing population of the Ohio Valley, with larger real income, more leisure time, and, because of the automobile, greater mobility, thronged to reservoir projects during the 1950s. General John Person, Louisville District Engineer, 1948-1950, said in testimony before the Senate Committee on Public Works in 1957:

At the time we built our [first] projects we did

not anticipate and I think could not have anticipated the very extensive and growing use and enjoyment by the public of the water areas in those reservoirs. They are used for fishing, boating, swimming, camping, picnicking, and related activities. Such use had increased from 16 million visits [Corps-wide] annually in 1950 to more than 70 million visitor days in 1956.³⁷

Full consideration of recreation as a purpose in project formulation and evaluation, giving new importance to recreation values, was approved by President John F. Kennedy in 1962. By 1968 the Corps of Engineers was serving more visitors (170 million) at its projects than any other federal agency; and recreational use of Corps projects was increasing at a rate exceeding that of any other federal agency. In 1972 the 400 Corps projects with recreation areas recorded 300 million "recreation days." This national "recreation explosion" stimulated support for reservoir projects in "upstream" areas near reservoir sites because the projects would provide nearby recreational opportunities and direct economic benefits by creating a tourist-service industry.³⁸

Water Supply

The water Supply Act of 1958 authorized the Corps of Engineers to plan water storage features in reservoir projects to serve the anticipated needs for industrial and municipal water supply. This authorization brought added support for reservoir projects from "upstream" interests in the Louisville District. Many communities experienced water shortages in the Louisville District during the drought of 1963 and became convinced they needed a dependable water source to meet their projected needs. This was particularly true at Glasgow, Kentucky (Barren River Reservoir); Leitchfield, Kentucky (Rough River Reservoir); Campbellsville, Kentucky (Green River Reservoir); Frank-

fort and Lexington, Kentucky (Red River Reservoir); and there was a marked increase in the interest in project water supply features in Indiana, where state government contracts for storage.³⁹

Water Quality

Water pollution problems have existed since the settlement of the Ohio Valley. Historian Henry McMurtrie observed in 1819 that construction of the Louisville and Portland Canal might alleviate the problem in the Louisville harbor and Beargrass Creek "whose sluggishness during the summer is . . . productive of consequences injurious to the health of the inhabitants of the town." The Corps of Engineers, as hydraulic experts, were also concerned with water pollution at an early date. Major Amos Stickney, Louisville District Engineer, 1886-1890, for example, conducted a campaign to stop the discharge of raw sewage from Louisville into the Ohio above the canal, asserting:

It is hardly necessary . . . to adduce proof of the ill results that might be expected from the impounding of such a quantity of the decaying and fetid matter that is constantly cast off by a populous city. The health of the employees of the canal, the durability of the various structures in it, and the health and well-being of all the inhabitants of the portion of the city fronting the canal, would undoubtedly be seriously affected.⁴⁰

Great public concern about the water-pollution problem in the Ohio Valley was first aroused in 1931 when, after the drought of 1930, an epidemic of gastroenteritis, directly attributable to the emission of untreated sewage into the waterways, swept down the Ohio River with the spring rise of 1931. This epidemic and similar incidents resulted in the organization of the Ohio River Valley Water Sanitation Commission (ORSANCO) to direct improvement of water quality in the Ohio

Basin under the authorities of the interstate Ohio River Sanitation Compact, and the authorization of a federal study of water pollution in the Ohio Basin — the first of its kind in the nation.⁴¹

One of the proponents of federal action on the water quality problem, Congressman Brent Spence of Kentucky, said in 1937 that the Ohio River, because of the volume and variety of wastes discharged into it, should be the "great national laboratory where this problem of such vital interest to the people may be solved." Congress prepared to authorize such a study in 1937, but was uncertain whether its performance should be assigned to the Corps of Engineers or the Public Health Service. General Edward M. Markham, Chief of Engineers, urged assignment of the mission to the Corps:

This organization is entirely familiar with the streams involved and possesses a large amount of data relating thereto which is essential in the determination of the best methods for pollution control. The feasibility of using this organization becomes apparent when it is realized that the solution of the pollution problem is an engineering matter. It is closely related to the hydrology of the streams with particular reference to the increase in their low water flow through the operation of dams and reservoirs authorized for flood control and for navigation.⁴²

General Markham referred in his last sentence to "low-flow augmentation," or controlled releases from reservoir to aid in maintaining navigable depths and reducing pollution problems which often developed during dry, low-water seasons. Even the Davis Island navigation project, completed on the Upper Ohio in 1885, was credited with reducing water pollution problems in the Pittsburgh area. "Low-flow augmentation" has been derided as mere "pollution dilution," but during the drought of 1963, when over 50% of the total flow of the Ohio River was

provided by releases from reservoirs, problems would have been much more acute and even hazardous to public health without this additional water supply. Graphically stated, the Ohio might have resembled in 1963 a residential flush commode where use continued when water for flushing was not available.⁴³

But reservoir projects with "low-flow augmentation" features had not been constructed in the Louisville District in 1937, when Congress decisively assigned the Ohio River pollution study to both the Corps and the Public Health Service. The cooperative report, described by the Chief of Engineers as the "most complete and comprehensive examination ever made into the sanitary conditions of a major river and its tributaries," was completed in 1943. This report provided detailed information about the seriousness of the Ohio Basin pollution problem and recommended vigorous countermeasures. But the national military effort engrossed public attention in 1943 and the report received little attention from either Congress or the public, and only minimal action was taken on its sweeping recommendations.⁴⁴

During the quarter-century following completion of the 1943 report, ORSANCO accomplished much toward improving water quality in the Ohio Basin, but the Corps was not involved to any great extent in the solution of the problem. The Water Pollution Control Act of 1961 authorized the Engineers to include water quality and flow regulation features in water resource project planning on a general basis; and in the late 1960s, as public concern mounted, the Corps was assigned a multifaceted water pollution study and reduction mission. Water Quality Units were established at District and Division levels, waste-water management studies were

initiated by OCE, and legal enforcement of water quality standards became a Corps mission. Federal courts determined the Refuse Act of 1899, originally enacted to prevent deposit of refuse in navigable channels, was also applicable to the discharge of pollutants into waterways. President Richard M. Nixon issued an Executive Order in 1971 establishing a permit program, enforced by the Corps, which required those discharging materials into the nation's rivers and lakes to meet stringent waste treatment standards. It appeared in 1975 that water quality maintenance would be a major continuing mission of the Corps of Engineers and the Louisville District.⁴⁵

Summary

The flood control program which began in the Louisville District in 1936 and 1937 had developed by 1975 into a comprehensive water resource development program as a result of the expansion of its scope by Congress over the years to include many additional project features. Public and political support for a particular project must be overwhelming before the Army Engineers recommend construction and before Congress provides funding. Local protection projects, whose benefits are limited to a small area, whenever local interests could agree to meet their obligation were constructed in large numbers in the Louisville District from the beginning

of the flood protection program. Flood control reservoirs, whose flood control benefits accrued chiefly to downstream areas, could not at first be constructed in the Louisville District because of intense public and political opposition from "upstream" interests. Citizens residing in reservoir areas could not be convinced the reduction of flood damages would compensate for the loss of their lands.

By authorizing such reservoir project features as water supply, recreation, fish and wildlife conservation, and pollution abatement, in addition to flood control, Congress established a multipurpose program with widespread benefits, for both up and down stream areas. And, in many cases, upstream interests began to support reservoir projects because of these multiple benefits and the economic improvements which such projects often stimulated.

The Corps comprehensive water resource program had revolutionary effects on living standards and life quality in the Lower Ohio Basin, as elsewhere in the nation, as it was implemented between 1936 and 1975. Changes occurred so slowly as to pass nearly unnoticed; nevertheless, a transformation with widespread political, economic, social, and cultural consequences transpired. The extent of the metamorphosis was indeed so pervasive that in the 1960s there were those who began to call for a halt to the Corps program.

EPILOGUE

The history of the Louisville District, Corps of Engineers, United States Army, did not end in 1975. As a matter of fact, the environmental preservation movement and the comprehensive development program were expanding the District mission and perspective and having considerable impact on District operations.

Environmental Focus

Concern for the preservation of environmental quality, or, as the expression went, the "ecology bag," gripped the attention of Americans during the late 1960s and early 1970s. Deteriorating water quality, air pollution, industrial waste, urban sprawl, and other problems confronting a technologically-advanced society were subjects of great public concern during the era. The environmental preservation movement was closely tied to a concurrent questioning of old values, of the equation of industrial and economic development and growth with progress in particular. The Army Engineers, who had previously thought of themselves, because of their attention to the scientific management of natural resources, as being in the forefront of the conservation movement, were surprised to find their organization under attack, accused of having a "beaver complex," of conjuring up "make-work" projects and destroying the natural environment with the water resource development program.

The predecessors of the environmental-preservationists were the conservationists of the early twentieth century who fought for the creation of a national park and forest reserve system to preserve the natural wonders and timber resources of America. But conservation of water resources at the turn of the century com-

monly meant conserving water behind dams to prevent floods and to put it to use for social and economic purposes, rather than letting it go to waste in annual floods. What the environmentalists actually did in the 1960s was extend the meaning of "conservation" as it had been originally applied to forest-land resources to water resources. The environmentalists of the 1960s resorted to legal action and public protests to bring suspension or reassessment of various water resource projects. Such action against two projects in the Louisville District — the Red River Reservoir in the Kentucky River Basin and the Big Walnut Reservoir in the Wabash Basin — received wide coverage in the national news media.¹

A review of the "Big Walnut Flap" will illustrate the character of the conflict. Big Walnut reservoir project, on Big Walnut Creek of Eel River, a tributary of the White River in central Indiana, was essentially an outgrowth of the comprehensive planning studies of the Wabash Basin performed by an interagency committee representing ten federal and state agencies during the 1960s. The Wabash Basin Coordinating Committee reported the Big Walnut project would reduce annual flood damages, provide additional water supply for the Indianapolis metropolitan area, improve water quality on Big Walnut Creek and Eel River, and furnish needed recreational opportunities. Testimony at public hearings on the proposed project indicated the usual "upstream" opposition in the project area, Putnam County, Indiana, was not appreciable, and, instead, citizens of the area overwhelmingly supported the project.²

Twenty-four project sites were examined, and a site near Greencastle, In-

diana, was selected for engineering and economic reasons. Several ecologically unique features were extant — an unusual timber stand and a blue heron rookery — and to facilitate study and use of these features a nature center, arboretum, canoe-launching ramps, paths for aquatic and forest interpretation, pioneer history museum, and watchtowers for observation of the rookery without disturbing the habitat were included as part of the project plans. Environmentalists maintained these features were not adequate; that too much of the area would be inundated at times by the reservoir; and about 1967 they launched a campaign to stop the project. Congress conditionally approved the Big Walnut project in 1968; and the Louisville District organized a Task Group, consisting chiefly of independent experts, to study the extent the project would damage ecological features and recommend alternative project sites or other methods of preserving the unique natural environment.³

The Task Group recommended in 1972 that the project damsite be moved about three and a half miles downstream and several additional management measures be adopted to reduce environmental damages. One of the more important recommendations of the Task Group was that representatives of environmentalist groups be included in project planning for natural areas. At a public hearing at Greencastle, Indiana, on January 18, 1972, environmentalists indicated their qualified approval of the Task Group recommendations. Thomas E. Dustin of the Izaak Walton League, a leader of opposition to the project, said:

In conclusion, we would note that for all of the controversy that has surrounded the Big Walnut project, the prospects have been considerably altered. From a project that could probably have

been stopped for many years, and perhaps permanently, it could well emerge as one of the few Wabash basin proposals that has any prospect of implementation in the foreseeable future.⁴

By 1970 the Louisville District was committed to full consideration of environmental features at every project, and involving representatives of environmentalist groups in project planning wherever appropriate. This commitment reflected a similar commitment of the Corps at the national level. Congressional legislation and Presidential orders had established governing environmental guidelines for the Corps civil works program, which were published in 1970, and General Frederick J. Clarke, Chief of Engineers, established an Environmental Advisory Board in 1970, to represent environmentalist groups, and met with it across the country — once in Louisville — on a regular basis. General Clarke summarized the reorientation of the Corps civil works program in 1971:

Our efforts in the Civil Works Program are changing somewhat in emphasis to reflect the public's growing desire that the development of our natural resources for economic benefits no longer be the sole criteria for our work. Rather, people seem willing to forego, or to pay more for, their immediate needs so that the quality of their environment may be preserved and enhanced for the future. In that light, environmental values are now being given full consideration along with economic, technical, social and other factors when we study alternate means of meeting human demands. We are attempting to keep resource options open for future generations as far as it is possible to do so.⁵

It was evident in 1975 that the protection of environmental quality through water-pollution reduction, improved waste-water management, environmental consideration in water resource planning, and related measures would become another primary mission of the Army Corps of Engineers and the Louisville

Engineer District.

Comprehensive Water Resource Planning

The basin-wide planning programs of the Corps must consider environmental impact, engineering efficiency, economical use of available capital, and related factors in planning water resource development to meet present and projected human needs. Corps plans must reconcile these elements in such a manner that proposed projects will be acceptable to an overwhelming majority of Americans. And as water-user demands and conflicts have grown, the problem of coordinating many desirable project purposes within the framework of basin and national water-resource development programs has become increasingly complex.

During the 1960s the Louisville District participated in three major comprehensive planning programs. The Wabash River Basin Comprehensive Survey and the Ohio River Basin Comprehensive Survey assessed the trends in water resource management, developed projections of future water needs in the basins under study, and recommended water and related land resource developments which would assure optimum contributions to the environmental, economic, regional, and social well-being of the population of the basins. These studies operated on a premise that well-planned water resource development would foster a balanced industrial and agricultural economy, providing greater employment opportunities in those basins, and thereby alleviate some of the problems of population concentration in already urbanized and industrialized areas.⁶

The Appalachian Water Resources Survey, authorized in 1965 and completed in 1968, was based on the same premise, as indicated by the authorizing act which di-

rected the Corps Engineers to: "prepare a comprehensive plan for the development and efficient utilization of the water and related resources of the Appalachian region, giving special attention to the need for an increase in the production of economic goods and services within the region as a means of expanding economic opportunities and thus enhancing the welfare of its people . . ."⁷

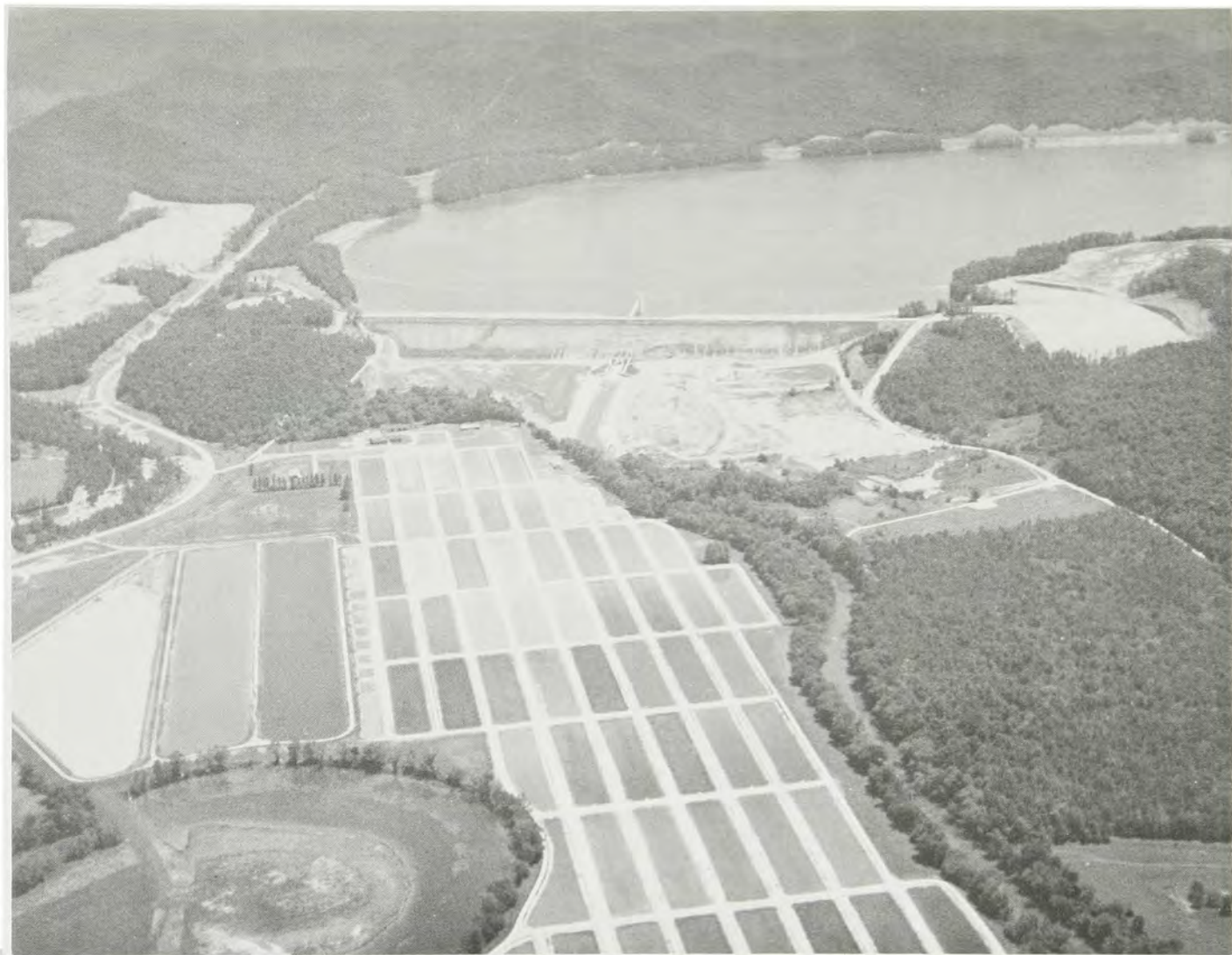
The history of the Louisville District and its civil works program indicated that industries were attracted to the Lower Ohio Basin by flood protection, increased water supply, economical waterways transportation, and other elements of the Corps water-resource development program, but assessing the total changes in the socio-economic environment of the region resulting from the Corps program was a complex problem. The question could be asked: "What would the Lower Ohio Basin be like in 1975 if the Louisville Engineer District and its predecessors, as agencies of the federal government and therefore the people of the United States, had not improved navigation, constructed flood control projects, and implemented other water-resource programs?" Answers would doubtless be diverse, depending upon the philosophy of the individual responding, but most, if not all, would concede that the region would have severe social and economic problems. How severe was an imponderable which has thus far defied analysis, but methods of assessing the total effects of water resource development were under study in 1975.

Conclusion

When George Washington, Thomas Hutchins, and other Army Engineers first visited the Ohio Valley on military and topographic missions in the eighteenth cen-



The Interpretative Center, Green River Lake, Kentucky



The Minor E. Clark Fish Hatchery adjacent to Cave Run Lake, Kentucky

tury, every river in the basin was a wild and scenic stream, unnavigable for lengthy periods during each year and a source of periodic floods. After Americans settled the region and utilized the waterways for commercial navigation, they demanded the rivers be made more navigable; and in 1824 Congress authorized a program to improve navigation and assigned the mission to the Corps of Engineers, United States Army. This mission was later expanded to include several Ohio River tributaries and, during the twentieth century, the transformation of the Ohio River into a dependable watercourse by the canalization and subsequent navigation modernization projects.

The first settlers in the Ohio Basin were prone to accept recurring floods philosophically, viewing them as acts of God about which little could be done, but as population increased and development in the flood plains grew flood damages increased proportionately and the people of the Basin began to demand effective measures to control floods and reduce their damages. The Army Engineers in the Ohio Valley were authorized to implement a large-scale flood control program in 1936. Other water uses were later recognized and the original flood control program was modified to provide for a multitude of water uses, which encompassed in 1975 so many different purposes that comprehensive water resource development, rather than flood control, was a more appropriate description of the Corps civil works program.

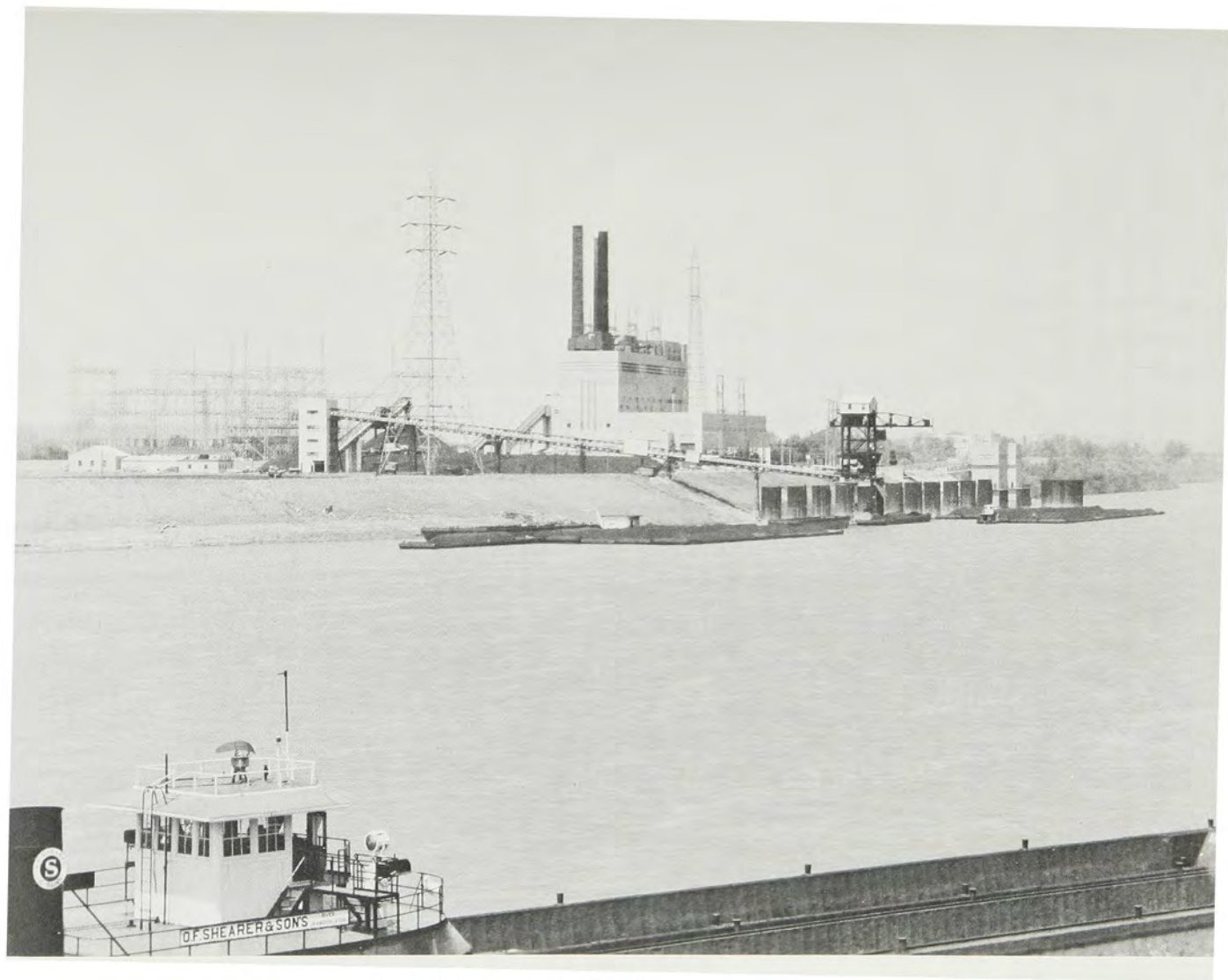
Thus, over a period of about two centuries, the original military mission of the Army Engineers in the Ohio Valley was expanded to include several primary civil works missions: navigation improvement, flood control, and multipurpose water resource development. By 1975 it was also

evident that the Corps had a fifth primary mission: the preservation and improvement of environmental quality.

These multifaceted missions made the operations of the Louisville District in 1975 extremely complex. In the nineteenth century the history of Army Engineer activities in the Ohio Valley was largely the story of outstanding individuals, like Colonel Stephen H. Long, Captain John Sanders, Captain Henry M. Shreve, Colonel William E. Merrill, and General Godfrey Weitzel, aided by small staffs and hired labor forces; by 1975 that history was largely the history of an institution and the historian could discuss the activities of the "district," confident that it would be clearly understood that the term encompassed the cooperative contributions of a large number of personnel. The Louisville District in 1975 included personnel trained in all major branches of engineering as well as specialized subdivisions, and scientists, technicians, and experts in many other fields, in addition to the hundreds of employees performing the normal operation and maintenance activities at locks, dams, reservoirs, and other installations.

It should be noted, however, that the number of District employees was less than it had been at previous periods, such as the era when large numbers of laborers were employed for the construction of Locks and Dams Nos. 41-53. This had been accomplished by resorting to contracts for most of the construction work, increased use of electronic computers, and administrative and operational centralization, reflecting developments which were Corps-wide and which were also characteristic of many other institutions in the late twentieth century.

Because the Louisville Engineer District ordinarily designed and built water-



River Industry on the Ohio River

ways and water resource projects with a projected life-span of fifty years or more, it was actually planning and building in 1975 to meet the needs of the Lower Ohio Basin in 2020 A. D. And it had no fear of the future, for during the two centuries the Army Engineers had operated in the Ohio

River Basin they served a viable and continuing need of the citizens of the United States for an engineering-construction agency which could respond effectively to demands for either defense construction or water resource development as circumstances required.



The Federal Building at Louisville
Engineer District Headquarters

CHAPTER I: FOOTNOTES

1. Biographical information about Colonel Richard Gridley is provided in Raleigh B. Buzzard, "America's First Chief Engineer," *Military Engineer*, XXIX (December, 1947), 505-10. An older administrative history of the Corps of Engineers is W. Stull Holt, *The Office of the Chief of Engineers of the Army: Its Non-Military History, Activities, and Organization* (Baltimore, 1923; cited hereinafter as Holt, OCE); and sketches of various aspects and periods of Corps history are found in Henry P. Beers, "A History of the U. S. Topographical Engineers, 1813-1863," *Military Engineer*, XXXIV (June-July, 1942), 287-91, 348-52; Edward Burr, "Historical Sketch of the Corps of Engineers, U. S. Army," *Occasional Papers: The Engineer School*, No. 71 (1939); William P. Craighill, "Corps of Engineers, United States Army," *Transactions of the American Society of Civil Engineers*, VIII (1897), 429-35; Henry C. Jewett, "History of the Corps of Engineers to 1915," *Military Engineer*, XIV (September-October, November-December, 1922), 304-06, 385-88; and A. A. Humphreys, "Historical Sketch of the Corps of Engineers," in U. S., Congress, House, *Reorganization of the Army*, H. Rept. 555, 45 Cong., 3 Sess., 1878, pp. 327-49.
2. A highly readable general account of the history of the Ohio Valley is Richard E. Banta, *The Ohio* (New York, 1949). Discussions of the explorations of La Salle are found in Thomas D. Clark, *Kentucky: Land of Contrast* (New York, 1968), and Frances Krauskopf, "The Documentary Basis for LaSalle's supposed Discovery of the Ohio River," *Indiana Magazine of History*, XLVII (June, 1951), 143-53. Krauskopf concludes that "LaSalle had no first-hand knowledge of the Ohio," *ibid.*, p. 153.
3. A reliable general account of the use of the Ohio Valley waterways for commerce is Charles H. Ambler, *A History of Transportation in the Ohio Valley* (Glendale, Calif., 1932; cited hereinafter as Ambler, *Transportation in Ohio Valley*); see pp. 1-29 for discussion of the "Canoe Age."
4. In addition to Salley, members of the expedition were John Howard, John Poteat, and Charles Sinckler. See the account of the voyage and pertinent documents in Fairfax Harrison, "The Virginians on the Ohio and the Mississippi in 1742," *Virginia Magazine*, XXX (April, 1922), 203-22 (the description of the Falls of the Ohio is printed on p. 214).
5. Jack L. Holmes, "Some French Engineers in Spanish Louisiana," and Samuel Wilson, Jr., "Colonial Fortifications and Military Architecture in the Mississippi Valley," in John F. McDermott, ed., *The French in the Mississippi Valley* (Urbana, Ill., 1965), 103-22, 123-42, are scholarly discussions of French Engineers; see also R. E. Banta, *The Ohio*, p. 60, and Emerson W. Gould, *Fifty Years on the Mississippi* (St. Louis, 1889), pp. 224, 310.
6. General accounts of the action at the Forks of the Ohio during the French and Indian War, which include discussions of the roles of Captain Le Mercier and George Washington, are Charles Morse Stotz, *Point of Empire: Conflict at the Forks of the Ohio* (Pittsburgh, 1970); Charles Morse Stotz and Alfred Procter James, *Drums in the Forest* (Pittsburgh, 1958); and Walter O'Meara, *Guns at the Forks* (Englewood Cliffs, N. J., 1965).
7. Nicholas Wainwright, *George Croghan, Wilderness Diplomat* (Chapel Hill, 1959; cited hereinafter as Wainwright, *Croghan*), pp. 91-93, describes the activities of Gage, Washington, Croghan, and Gordon in 1755.
8. George Washington to President of Congress, December 14, 1784, in John C. Fitzpatrick, ed., *The Writings of George Washington*, XXVIII (Washington, D. C., 1938), 11. The support of General Washington for the training of American military engineers, for free navigation, and for internal improvements may be traced in this multivolume printing of his works; most biographies of Washington also discuss his opinions on these subjects.
9. Thomas Jefferson, *Notes on the State of Virginia* (Philadelphia, 1801), pp. 15-18.
10. Johann D. Schoepf, *Travels in the Confederation* [1783-1784], trans. by Alfred J. Morrison (Philadelphia, 1911); "Journal of Arthur Lee," in John W. Harpster, ed., *Pen Pictures of Early Western Pennsylvania* (Pittsburgh, 1938), p. 155; "News from the Ohio," in *Ohio Archaeological and Historical Publications*, XLV (1936), 371-73.
11. The authoritative biography of Thomas Hutchins is Anna Margaret Quattrocchi, "Thomas Hutchins, 1730-1789" (unpublished Ph.D. dissertation, University of Pittsburgh, 1944; cited hereinafter as Quattrocchi, "Hutchins").
12. Letter from General Forbes' Army, Pittsburgh, November 28, 1758, in S. K. Stevens, Donald H. Kent, and Autumn L. Leonard, es., *The Papers of Henry Bouquet: Vol. II The Forbes Expedition* (Harrisburg, 1951), p. 613. Hutchins served as quartermaster in this expedition.
13. Quattrocchi, "Hutchins," pp. 50-67; Wainwright, *Croghan*, pp. 167-94.
14. Quattrocchi, "Hutchins," pp. 68-76; Wainwright, *Croghan*, pp. 220-23.
15. Thomas Gage to Harry Gordon, May 9, 1766, William L. Clements Library, University of Michigan.
16. *Ibid.*
17. Ambler, *Transportation in Ohio Valley*, pp. 32-33; Wainwright, *Croghan*, pp. 233-35; Quattrocchi, "Hutchins," pp. 79-83.
18. Wainwright, *Croghan*, pp. 212-14, 233-35; Quattrocchi, "Hutchins," pp. 79-83. The most interesting first-hand account of the voyage is George Morgan to Molley, June 20-28, 1766, Manuscript Section, Illinois Historical Survey.
19. The journal kept by Captain Gordon during the expedition has been reprinted several times; see *Journal of Illinois State Historical Society*, II (1909), 55-64 (description of the Falls of the Ohio on p. 58).
20. Beverly Bond, Jr., ed., *The Courses of the Ohio River taken by Lt. T. Hutchins, Anno 1776, and Two Accompanying Maps* (Cincinnati, 1942). Bond states that Hutchins' map of the Falls of the Ohio "was of greatest importance in opening up this difficult stretch of water to navigation," *Ibid.*, p. 13. Thomas Hutchins Papers, 1759-88, are in Historical Society of Pennsylvania, Philadelphia.
21. The 60th "Royal American" Regiment of Foot was organized during the French and Indian War by the Earl of Loudoun, and especially distinguished itself at the Battle of Quebec. During the American Revolution it served in the West Indies; it became the first British unit to be armed with rifles, rather than muskets, and the first to use the green uniform to reduce visibility in combat. In the twentieth century it became known as the King's Royal Rifle Corps. Refer to Emil John Ruckert, "Governors Island and the Royal American Regiment," *Journal of the American Military History Foundation*, I (Fall, 1937), 130-31. Discussion and description of the second trip down the Ohio and the construction of the Gage may be located in Quattrocchi, "Hutchins," pp. 95-98; "Affairs at Fort Chartres, 1768-1781," *The Historical Magazine*, VIII (August, 1864), 258-63; Clarence Alvord and Clarence E. Carter, eds., *Trade and Politics, 1767-1769* (Springfield, Ill., 1921); and the escape of Hutchins is mentioned in Clarence E. Carter, ed., *The Correspondence of General Thomas Gage with the Secretaries of State, 1763-1775* (2 vols. New Haven, 1931), I, 309.
22. Thomas Hutchins, *A Topographical Description of Virginia, Pennsylvania, Maryland, and North Carolina*, edited by Frederick C. Hicks (reprint of 1778 London edition; Cleveland, 1904). This edition prints a bibliography of Hutchins' works and related materials and a biography of Hutchins by Frederick C. Hicks, but the latter is superseded by Quattrocchi. "Hutchins." Quattrocchi states the contem-

poraries of Hutchins credited him with laying the foundation for American geography; see p. 347.

23. Quattrocchi, "Hutchins," pp. 201-02. Copies of Hutchins' correspondence with Wharton are in British Transcripts, Manuscript Division, Library of Congress. The recommendation from Franklin stated that Hutchins, "a native of New Jersey . . . has lately escaped from England where he suffered considerably for his attachment to the American cause." He is, said Franklin, a "good officer and an excellent engineer." Benjamin Franklin to President of Congress, March 16, 1780, in John Bigelow, ed., *The Works of Benjamin Franklin*, VIII (New York, 1904), 203-04. The claim that Hutchins was the first Chief of Topographical Engineers was made in Edward Burr, "Historical Sketch of the Corps of Engineers, U. S. Army," *Occasional Papers: The Engineer School*, No. 71 (1939), p. 34. James A. James, *The Life of George Rogers Clark* (Chicago, 1928), pp. 394-95, describes the Hutchins-Morgan colonizing attempt at New Madrid.

24. Burr, "Historical Sketch of the Corps of Engineers, U. S. Army," p. 1.

25. Raleigh B. Buzzaird, "Washington's Favorite Engineer," *Military Engineer*, XL (March, 1948), 115-18.

26. Burr, "Historical Sketch of the Corps of Engineers, U. S. Army," p. 1; A. A. Humphreys, "Historical Sketch of the Corps of Engineers," in U. S., Congress, House, *Reorganization of the Army*, H. Rept. 555, 45 Cong., 3 Sess., 1878, pp. 327-332. A scholarly study of the organization and activities of the Corps of Artillerists and Engineers, 1794-1802, would be a valuable addition to the history of the United States and would shed considerable light on the history of the Ohio Valley frontier.

27. Dwight L. Smith, ed., "The Ohio River in 1801: Letters of Jonathan Williams, Junior," *Filson Club Historical*

Quarterly, XXVII (July, 1953), 199-222, prints a biography of Williams and his correspondence while on assignment in the Ohio Valley.

28. *Ibid.*

29. *Ibid.*, p. 207.

30. *Ibid.*, pp. 211-12.

31. *Ibid.*; see also Norman W. Caldwell, "Cantonment Wilkinsonville," *Mid-America*, XXXI (January, 1949), 3-28.

32. James McHenry to House of Representatives, January 31, 1800, printed as House Document No. 40, 6 Cong., 1 Sess., 1800.

33. Holt, *OCE*, pp. 12; Corps of Engineers Museum [Fort Belvoir, Va.], *Geneses of the Corps of Engineers* (unpaginated pamphlet; Fort Belvoir, 1953), provides biographical information and a portrait of Jonathan Williams.

34. Holt, *OCE*, p. 3; A. A. Humphreys, "Historical Sketch of the Corps of Engineers," *passim*. The duties of the Topographical Engineers, as described in the Rules and Regulations of the Army in 1813, were: "To make such surveys, and exhibit such delineation of these, as the commanding General shall direct; to make plans for all military positions (which the Army may occupy) and of their respective vicinities, indicating the various roads, rivers, creeks, ravines, hills, woods, and villages to be found therein; to accompany all reconnoitering parties sent out to obtain intelligence of the movements of the enemy."

35. See the excellent work of William H. Goetzmann in *Army Exploration in the American West, 1803-1863* (New Haven, 1959), and *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York, 1966). His studies constitute, in aggregate, a major revision of the Turner "frontier thesis," insofar as it applies to the American frontier west of the Mississippi.

CHAPTER II: FOOTNOTES

1. Descriptions of the unimproved Ohio River written by waterways engineers who were well acquainted with the subject and made precise measurements may be located in William L. Sibert, "The Improvement of the Ohio River," *Transactions of the American Society of Civil Engineers*, LXIII (June, 1909), 391; and Robert R. Jones, "The Ohio River: A Brief Account of the Considerations which Led to the Present Project for Its Canalization" (unpublished 30 page manuscript, dated Cincinnati, March 27, 1922, in National Archives, Record Group 77, Records of the Office of the Chief of Engineers, at Kansas City Federal Records Center, Box NA1141, Folder—Ohio 450). General Sibert served as Louisville and Pittsburgh District Engineer at the beginning of the twentieth century; Robert R. Jones was Assistant Engineer in the Louisville and Cincinnati Engineer Districts for many years and surveyed many sections of the Ohio River before it was canalized. Records of the Office of the Chief of Engineers, Record Group 77, National Archives, are cited hereinafter as NA, RG 77.

2. The effects of seasonal navigation on economic activities in the Ohio Valley are discussed in Louis C. Hunter, *Studies in the Economic History of the Ohio Valley*, Vol. XIX: *Smith College Studies in History* (Northampton: Smith College History Department, 1933-34), pp. 5-23.

3. *Ibid.*

4. Dale Van Every, *Ark of Empire: The American Frontier, 1784-1803* (New York, 1963), discusses Ohio River flatboat traffic and its relation to the settlement of the frontier; hundreds of descriptions of flatboats and their navigation are available, both in print and in manuscripts preserved in libraries in the Ohio Valley. The description

quoted is from Francois A. Michaux, *Travels to the West of the Alleghany Mountains*, reprinted in Reuben G. Thwaites, ed., *Early Western Travels*, Vol. III (Cleveland, 1904), 166.

5. Van Every, *Ark of Empire: The American Frontier, 1784-1803*, p. 35-36; John W. Harpster, ed., *Pen Pictures of Early Western Pennsylvania* (Pittsburgh, 1938), pp. 257-58, 265-67.

6. Guillaume Tell Poussin, *The United States: Its Power and Progress*, trans. by Edmund L. Du Barry (1st American edition; Philadelphia, 1851), p. 348. This volume is a history of the United States written by Captain Poussin after his return to France in 1832. He served in the Corps of Engineers from 1817 to 1832, and later served France as Ambassador to the United States. Poussin traveled the Ohio in a flatboat in 1817 and surveyed the river in 1821. He also implied that he had navigated the Ohio in 1806.

7. W. Wallace Carson, "Transportation and Traffic on the Ohio and the Mississippi before the Steamboat," *Mississippi Valley Historical Review*, VII (June, 1920), 33-35.

8. Mary Verhoeff, *The Kentucky River Navigation, Filson Club Publications*, No. 28 (Louisville, 1917), p. 53n. The history of the Tardiveau and Holker enterprises and pertinent documents are printed in "News From the Ohio Valley as Reported by Barthélemy Tardiveau in 1783," *Bulletin of the Historical and Philosophical Society of Ohio*, XVI (October, 1958), 267-92.

9. Walker Daniel to B. Tardiveau, February 22, 1783, and John May to B. Tardiveau, February 18, 1783, in "News from the Ohio Valley as Reported by Barthélemy Tardiveau in 1783," *Bulletin of the Historical and Philosophical Society of Ohio*, XVI (October, 1958), 281

285.

10. *Ibid.*, pp. 282-84.
11. *Ibid.*, pp. 288-89. Pierre Tardiveau settled near Bowling Green, Kentucky, in 1798 and died there in 1835. See Thomas C. Cherry, "Robert Craddock and Peter Tardiveau: Two Revolutionary Soldiers of Warren County, Kentucky," *Filson Club History Quarterly*, IV (April, 1930), 78-90.
12. Verhoeff, *The Kentucky River Navigation*, pp. 55-58.
13. Thomas D. Clark, *The Kentucky* (New York, 1942), Rivers of America series edited by Stephen Vincent Benet and Carl Carner, pp. 54-63; Ambler, *Transportation in Ohio Valley*, pp. 72-73; Harlow Lindley, ed., *Indiana as Seen by Early Travelers*, Vol. III of *Indiana Historical Collections* (Indianapolis, 1916), pp. 31-32; Niles' *Weekly Register*, I (September 7, 1811), 10.
14. Consult James A. James, *Life of George Rogers Clark* (Chicago, 1928), for extensive details. An excellent military analysis of the Clark expedition is Joseph L. Lambert, "Clark's Conquest of the Northwest," *Indiana Magazine of History*, XXXVI (December, 1940), 337-50.
15. Verhoeff, *The Kentucky River Navigation*, pp. 68-69; Ambler, *Transportation in Ohio Valley*, p. 71; Henry McMurtrie, *Sketches of Louisville and Its Environs* (Louisville, 1819), pp. 155-57; Archer B. Hulbert, *The Paths of Inland Commerce: A Chronicle of Trail, Road, and Waterway* (New Haven, 1920), in *Chronicles of America Series* edited by Allen Johnson, pp. 74-75. A scholarly study of customs collection and the creation of ports of entry on the inland rivers would be a valuable addition to American transportation and taxation history, for the sources listed above often conflict.
16. Ambler, *Transportation in Ohio Valley*, pp. 97-106; Richard T. Wiley, "Ship and Brig Building on the Ohio and Its Tributaries," *Ohio Archaeological and Historical Publications*, XXII (1913), 54-64.
17. Doyce B. Nunis, Jr., "Tarascon's Dream of an American Commercial Empire in the West," *Mid-America*, XLII (July, 1960), 170-84, is a scholarly and interpretative study of the firm and the life of Louis Tarascon.
18. Leland D. Baldwin, "Shipbuilding on the Western Waters, 1793-1817," *Mississippi Valley Historical Review*, XX (June, 1933), 29-34; Ambler, *Transportation in Ohio Valley*, pp. 97-106.
19. Leland D. Baldwin, *The Keelboat Age on Western Waters* (Pittsburgh, 1941), pp. 1-45. Though many studies of inland river navigation have touched on the subject of keelboats, the Baldwin volume is the definitive work.
20. *Ibid.*, pp. 44-45. The description of the superstructure of the keelboat was written by Noah Ludlow, a traveling theatrical troupe manager who owned and journeyed on many keelboats; see Noah M. Ludlow, *Dramatic Life as I Found It* (New York, 1966), p. 55.
21. Baldwin, *The Keelboat Age on Western Waters*, pp. 62-64; see also the contemporary account in Timothy Flint, *Recollections of the Last Ten Years* (New York, 1968), pp. 24-25; 91-92.
22. The claims and comments of General Wilkinson were printed in *Proceedings of the Managers of the Ohio Canal Company at Louisville on Wednesday, the 11th Day of September, 1805* (pamphlet; Lexington, 1805), p. 12.
23. Robert R. Jones, "The Ohio River" (unpublished 125 page manuscript, dated 1920; NA, RG 77, in Kansas City Federal Records Center, Box NA1141, Folder—Ohio 450), p. 9; Elias Pym Fordham, *Personal Narrative of Travels ... 1817-1818* (Cleveland, 1906), pp. 121-22, provides information on keelboat management; additional information about the economics of the keelboat is furnished in *S&D Reflector*, V (June, 1968), 10.
24. Carson, "Transportation and Traffic on the Ohio and the Mississippi before the Steamboat," pp. 32-33. Cave-in-Rock and Fort Massac are now the sites of Illinois state parks. Several accounts of the activities of the pirates and boatwreckers have been written, but those interesting stories are beyond the scope of this narrative. Robert R. Jones of the Louisville and Cincinnati Engineer Districts carefully explored the Cave-in-Rock in 1912 and made some interesting discoveries; at that time the famous Cave was used as a shipyard where small boats were built and launched into the Ohio.
25. Fordham, *Personal Narrative of Travels ... 1817-1818*, pp. 195-96; see also remarks of Morris Birkbeck printed in Lindley, ed., *Indiana as Seen by Early Travelers*, p. 176.
26. John Q. Anderson, "Up Salt Creek Without a Paddle," *Register of Kentucky State Historical Society*, LIV (April, 1956), 147-52; John James Audubon, "Sailing Down the Ohio," *Family Magazine*, I (1836), 72.
27. Ambler, *Transportation in Ohio Valley*, pp. 48-49; Miles A. Stacy, "Flatboating from Marietta to New Orleans Described," *S&D Reflector*, VI (December, 1969), 27-28; Baldwin, *The Keelboat Age on Western Waters*, pp. 193-95; see also Louisville *Courier-Journal*, October 29, 1929, which prints a photograph of a flatboat and its story—it traveled down the Ohio in 1898.
28. Arthur E. Hopkins, "Steamboats at Louisville and on the Ohio and Mississippi Rivers," *Filson Club History Quarterly*, XVII (July, 1943), 143-62; Thomas D. Clark, *Kentucky: Land of Contrast* (New York, 1968), pp. 35, 65-68; Louis C. Hunter, *Steamboats on the Western Rivers: An Economic and Technological History* (Cambridge, Mass., 1949), pp. 1-62. Hunter's history is definitive on most aspects of steamboat history. An invaluable tool for the study of steamboat history is the *S&D Reflector* published by the Sons and Daughters of Pioneer Rivermen and edited by Captain Frederick Way, Jr., of Sewickley, Pennsylvania. More than eight volumes have thus far been published. Trade Journals, such as *Waterways Journal*, can also be of use, but lack adequate indexes.
29. Verhoeff, *The Kentucky River Navigation*, p. 96n; C. W. Hackensmith, "John Fitch: A Pioneer in the Development of the Steamboat," *Register of the Kentucky State Historical Society*, LXV (July, 1967), 187-211.
30. Quattrocchi, "Hutchins," p. 351; John Fitch to Thomas Hutchins, June 15, 1787, and January 27, 1788, in John Fitch Papers, Manuscript Division, Library of Congress; comments of George Washington, dated September 7, 1784, on the Rumsey boat are also in Volume I of *ibid.*
31. Thomas D. Clark, *The Kentucky*, pp. 156-60; Ambler, *Transportation in Ohio Valley*, pp. 111-24; John H. B. Latrobe, *The First Steamboat Voyage on the Western Waters* (Baltimore, 1871), pp. 16-22.
32. Ambler, *Transportation in Ohio Valley*, pp. 124-29.
33. Several biographies of Captain Shreve have been published, but the most useful to date is Florence L. Dorsey, *Master of the Mississippi: Henry Shreve and the Conquest of the Mississippi* (Boston, 1941; cited hereinafter as Dorsey, *Master of the Mississippi*). Henry McMurtrie, *Sketches of Louisville and Its Environs*, pp. 194-97.
34. McMurtrie, *Sketches of Louisville and Its Environs*, pp. 194-97, 201; Hunter, *Steamboats on the Western Rivers*, pp. 15, 133. Hunter believed that Shreve's contributions to steam navigation have at times been "overstated."
35. Edwin A. Davis and John C. L. Andreasen, eds., "From Louisville to New Orleans in 1816: Diary of William Newton Mercer," *Journal of Southern History*, II (1936), 393-94. Mercer was a passenger on the Washington on its first trip. See also Hunter, *Steamboats on the Western Rivers*, pp. 17-20.
36. Richard G. Wood, *Stephen Harriman Long, 1784-1864: Army Engineer, Explorer, Inventor* (Glendale, Calif., 1966), pp. 59-84. This is the authoritative biography of Long, cited hereinafter as Wood, *Long*.
37. *Ibid.*: Hunter, *Steamboats on the Western Rivers*, p.

150; Roger L. Nichols, "Army Contributions to River Transportation, 1818-1825," *Military Affairs*, XXXIII (April, 1969), 242-49; John T. Starr, "Long's Expedition to the West," *Military Engineer*, LIII (March-April, 1961), 116-18. The claim has been made that the *Western Engineer* was the first sternwheel steamboat, but see Frederick Way, Jr., "Early Sternwheelers Were Not Sternwheelers," *Cincinnati Historical Bulletin*, XIII (October, 1955), 295-301.

38. *Pittsburgh Mercury*, April 30, 1819.

39. *Louisville Public Advertiser*, May 22, 1819. Other scientists and Engineer officers were also involved in the expedition in various capacities; see Wood, Long, pp. 59-84.

40. Stephen H. Long to John C. Calhoun, February 20, 1821 (report on the expedition in a bound volume), pp. 106-07, NA, RG 77.

41. *Ibid.*, pp. 11-12. See the discussion of the duration and effect of the low-water period of 1819-20 in Chapter III, *infra*.

42. Hunter, *Steamboats on the Western Rivers*, pp. 25-26; Theodore G. Gronert, "Trade in the Blue-Grass Re-

gion, 1810-1820," *Mississippi Valley Historical Review*, V (December, 1918), 317-23.

43. McMurtrie, *Sketches of Louisville and Its Environs*, p. 193; Timothy Flint, *Recollections of the Last Ten Years*, p. 377. *Louisville Public Advertiser*, March 6, 1819, printed an editorial on the subject: "It is highly gratifying to witness the rapid progress of the western country in wealth and national importance. It has been but eight years since the first steam boat was launched . . . and before the close of 1819, the number employed in the trade . . . will . . . exceed one hundred!"

44. Hunter, *Steamboats on the Western Rivers*, pp. 33-34, 105-08, 123; Ambler, *Transportation in Ohio Valley*, pp. 160-61; McMurtrie, *Sketches of Louisville and Its Environs*, pp. 127-32. Several studies of steamboat construction at individual ports have been published; see, for example, Victor M. Bogle, "New Albany's Attachment to the Ohio River," *Indiana Magazine of History*, XLIX (September, 1953), 250-66.

45. Poussin, *The United States: Its Power and Progress*, p. 350; see also Timothy Flint, *Recollections of the Last Ten Years*, p. 107.

CHAPTER III: FOOTNOTES

1. Holt, *OCE*, pp. 4-5; Victor L. Albjerg, "Internal Improvements without a Policy," *Indiana Magazine of History*, XXVIII (June, 1932), p. 168.

2. George Washington to Governor William Moultrie, May 25, 1786, in John C. Fitzpatrick, ed., *The Writings of George Washington*, Vol. XXVIII (Washington: Government Printing Office, 1938), 439. Summaries of the views of the Presidents, 1789-1860, are provided in Victor L. Albjerg, "Internal Improvements without a Policy," *passim*; and William R. Willoughby, "Early American Interest in Waterway Connections between the East and West," *Indiana Magazine of History*, LII (December, 1956), 319-42.

3. *Kentucky Gazette* (Lexington), July 6, 1801, prints the act signed by Adams on March 3, 1801, Holt, *OCE*, pp. 4-5.

4. Report of Secretary of Treasury on "Roads and Canals," April 6, 1808, in U. S., Congress, *American State Papers*, Class X: *Miscellaneous* (2 vols.; Washington: Gales and Seaton, 1834), I, 724-921. *American State Papers* is a convenient multivolume printing of early government documents; it is cited hereinafter as ASP. The remarks of Congressman Peter Porter in support of internal improvements are of great interest; see *Annals of Congress*, 11th Congress, 2 Session, February 8, 1810, 1385-1401.

5. *Louisville Public Advertiser*, January 5, 1822; *Niles' Weekly Register*, IX (November 18, 1815), 202, said: "The exigencies of the nation, during the late war, has raised up an astonishing zeal in all parts of the United States, to secure all those advantages of roads, bridges and canals, & c. which our country so happily presents to us." See also Bereton Greenhouse, "A Note on Western Logistics in the War of 1812," *Military Affairs*, XXXIV (April, 1970), 41-44.

6. The report of the Board of Engineers for Fortifications, February 15, 1881, is printed in ASP, Class V: *Military Affairs*, II, 305; Guillaume Tell Poussin, *The United States: Its Power and Progress*, pp. 376-79.

7. Report of Secretary of War on "Roads and Canals," January 14, 1819, is printed in ASP, Class X: *Miscellaneous*, II, 533-37 (quote on p. 534).

8. *Niles' Weekly Register*, XV (December 12, 1818), 267; Joseph Proud to Nathaniel G. Maxwell, December 22, 1819, in William D. Hoyt, Jr., ed., "From Pittsburgh to Shawneetown, 1819," *Ohio Archaeological and Historical*

Publications, LVI (1947), 94-97; *Louisville Public Advertiser*, February 1 and 2, 1820.

9. *Louisville Public Advertiser*, October 13, 1819, and January 5, 8, 1820. "Reconnaissance of the Ohio River above the Falls Made in 1819 by Commissioners Appointed by the States of Virginia, Kentucky, Pennsylvania, and Ohio," November 2, 1819. This original manuscript and accompanying maps was located in the files of the Louisville Engineer District in 1966; see *Louisville Times*, July 16, 1966, for an account of the rediscovery of the papers. Copies were made and placed on file at a number of libraries in the Ohio Valley.

10. *Niles' Weekly Register*, XIX (November 11, 1820), 170. Information about the Pennsylvania project is furnished in *Pittsburgh Post Gazette*, October 21, 1824, and James St. Clair Morton, *Memoir of the Life and Services of Capt. and Brevet Major John Sanders* (Pittsburgh: W. S. Haven 1861), pp. 8-9.

11. See remarks of President James Monroe, January 22, 1823, in U. S., Congress, House, *Message from the President of the United States transmitting a Report of the Board of Engineers on the Ohio and Mississippi Rivers, Made in the Year 1821*, H. Ex. Doc. No. 35, 17 Cong., 2 Sess., 1823, p. 3, and the accompanying report. *Louisville Public Advertiser*, June 6, 1821, and October 13, 1821. Biographical information is located in William H. Carter, "Bvt. Maj. Gen. Simon Bernard," *Professional Memoirs*, V (May-June, 1913), 306-14; Cyrus B. Comstock, "General Joseph G. Totten, Hon. M. ASCE," *Transactions of the American Society of Civil Engineers*, XXXVI (December, 1896), 525-27. Two of Captain Poussin's excellent histories are *The United States: Its Power and Progress* (previously cited), and *Travaux d'Améliorations Intérieures, Projets ou Exécutés par le Gouvernement Général des Etats-Unis d'Amérique de 1824 à 1831* Paris: Anselin, Libraire, 1834).

12. *Louisville Public Advertiser*, October 23, 1821.

13. General Alexander Macomb to John C. Calhoun, November 14, 1822, in ASP, Class V: *Military Affairs*, II, 458. The recommendations of the board are printed in U. S., Congress, House, *Message from the President of the United States transmitting a Report of the Board of Engineers on the Ohio and Mississippi Rivers, Made in the Year 1821*, H. Ex. Doc. No. 35, 17 Cong., 2 Sess., 1823. The maps prepared

by the Board are on microfilm at Surveys Branch, Louisville Engineer District.

14. Curtis Nettels, "The Mississippi Valley and the Constitution, 1815-1829," *Mississippi Valley Historical Review*, XI (December, 1924), 332-38; *Louisville Public Advertiser*, May 2, 1821.

15. See remarks of Rep. Holcombe of New Jersey, January 13, 1824, in *Annals of Congress*, 18 Cong., 1 Sess., 1021, and subsequent debates over the issues relating to internal improvements during that session of Congress.

16. See comments of Congressman Wickliffe printed in *Louisville Public Advertiser*, June 2, 1824.

17. Henry Clay, "Speech on Internal Improvements," January 14, 1824, printed in James F. Hopkins and Mary W. M. Hargreaves, eds., *The Papers of Henry Clay*, Vol. III: *Presidential Candidate, 1821-1824* (Lexington: University of Kentucky, 1963), pp. 572-93; *Washington Daily National Intelligencer*, July 31, 1824; *Annals of Congress*, 18 Cong., 1 Sess., 2578-83.

18. A convenient printing of most legislation relating to the Corps of Engineers and the improvement of waterways is United States Army, Office of the Chief of Engineers, *Laws of the United States Relating to the Improvement of Rivers and Harbors, from August 11, 1790 to January 2, 1939* (3 vols. and 2 indices; Washington, 1913 and 1940). Volume I, pp. 26-28, prints the General Survey Act and the first Rivers and Harbors Act. This work is cited hereinafter as *Rivers and Harbors Laws*.

19. Holt, OCE, pp. 5-9; ASP, Class X: *Miscellaneous*, II, 533-37; ASP Class V: *Military Affairs*, II, 698-701; *Annals of Congress*, 18 Cong., 1 Sess., 2558. A history of the activities of the Board of Internal Improvements is provided by Forest G. Hill, *Roads, Rails & Waterways* (Norman, 1957).

20. Wood, Long, pp. 145-46; U. S., Congress, House, *Sand Bars of the Ohio River*, H. Ex. Doc. No. 145, 19 Cong., 1 Sess., 1826.

21. *Ibid.*, U. S. Congress, Senate, *A Report of the Chief Engineer Relative to the Application of the Appropriations for Removing Obstructions to the Navigation of the Ohio and Mississippi Rivers*, S. Doc. No. 14, 19 Cong., 1 Sess., 1826, pp. 28-31; W. T. Rossell to Alexander Mackenzie, November 6, 1906, in Vol. III of "Ohio River Board Records" (3 bound volumes of correspondence, minutes, and misc. materials; Kansas City Federal Records Center, NA, RG 77), iii, n. p. Major Long warned navigation interests that construction was in progress and advised that the structure would be marked by white flags in daytime and red lanterns at night; *Louisville Public Advertiser*, November 6, 1824. See Comments on the success of the experiment in *Louisville Public Advertiser*, November 23, 1825, and February 25, 1826. The latter issue stated: "The result of this experiment cannot but be highly satisfactory to the learned and scientific gentlemen, under whose direction the work has been performed. If we can have four feet water, or three either in the Ohio river, at all seasons, a new era will commence, in its navigation, which will throw all other conveyance in the shade."

22. Elias Pym Fordham, *Personal Narrative of Travels in Virginia, Maryland, Pennsylvania, Ohio, Indiana, Kentucky: And of a Residence in the Illinois Territory, 1817-1818*, edited by Frederic A. Ogg (Cleveland, 1906), pp. 81-82; Henry Vose to John C. Calhoun, August 19, 1824, "Plans for Removal of Obstructions in the Mississippi and Ohio Rivers, 1824-1825," NA, RG 77 (this collection cited hereinafter as "Plans for Removal," NA, RG 77).

23. *Louisville Public Advertiser*, June 19, 1824.

24. "Plans for Removal," NA, RG 77; Charles De Hass to John C. Calhoun, August 17, 1824, *ibid.*; Emerson Gould, *Fifty Years on the Mississippi*, p. 193, mentions that United States troops frequently ascended the Ohio in boats similar to ferry-flats, propelled by men walking a tread-wheel.

25. See the proposed devices and accompanying diagrams

in "Plans for Removal," NA, RG 77.

26. *Louisville Public Advertiser*, June 19, 1824; "Plans for Removal," NA, RG 77; Samuel McKee to John C. Calhoun, August 31, 1824, *ibid.*

27. John Bruce was distantly related to Congressman Henry Clay; he served in the Kentucky legislature in 1827 and 1829 as a Whig. Among the recommendations he took with him to Washington was one from Henry Clay, which said in part: "I take great pleasure in expressing my belief that entire confidence may be placed in his faithful execution of any contract that he may make with Government for that purpose." Henry Clay to John C. Calhoun, August 15, 1824, in Hopkins and Hargreaves, eds., *The Papers of Henry Clay*, III, 810. This John Bruce should not be confused with the Lexington manufacturer of the same name who was also associated with Henry Clay. Contract negotiations may be traced in John Bruce to John C. Calhoun, August 31, and September 3, 1824, "Plans for Removal," NA, RG 77; Alexander Macomb to John Bruce, September 23, 1824, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77.

28. The contract is printed in U. S., Congress, Senate, *A Report of the Chief Engineer Relative to the Application of the Appropriation for Removing Obstructions to the Navigation of the Ohio and Mississippi Rivers*, S. Doc. No. 14, 19 Cong., 1 Sess., 1826, pp. 7-8. Reuben A. Carter to Alexander Macomb, October 19, 1824, "Plans for Removal," NA, RG 77; Edward Clark to John C. Calhoun, August 16, 1824, *ibid.*

29. "Survey of the Works at Fort Delaware, and Proceedings of a Court-Martial of Major Babcock," in ASP, Class V: *Military Affairs*, II, 792-822; Alexander Macomb to Samuel Babcock, November 16, 1824, U. S., Congress, Senate, *A Report of the Chief Engineer*, S. Doc. No. 14, 19 Cong., 1 Sess., 1826, pp. 9-10.

30. Alexander Macomb to Samuel Babcock, March 5, 1825, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77.

31. U. S., Congress, Senate, *A Report to the Chief Engineer*, S. Doc. No. 14, 19 Cong., 1 Sess., 1826, pp. 11-12.

32. *Ibid.*; Alexander Macomb to Samuel Babcock, June 14, 1825, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77.

33. See the contract in Senate Document No. 14, 19 Cong., 1 Sess., 1826, pp. 7-8.

34. *Ibid.*, *passim*; Samuel Babcock, "Journal of A Tour of Duty Performed by the Orders of the War Department to Superintend and Inspect the Operations, in Clearing the River Ohio and Mississippi from the Obstructions called Planters, Sawyers, &c (June 30, 1825-April 15, 1826)," Court Martial Case Files, 1809-1894. Records of the Office of Judge Advocate General (Army), Record Group 153, National Archives (cited hereinafter as "Babcock Case," NA, RG 153).

35. Alexander Macomb to Samuel Babcock, October 27, 1825, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77; Senate Document No. 14, 19 Cong., 1 Sess., 1826, prints the complaints.

36. Senate Document No. 14, 19 Cong., 1 Sess., 1826, pp. 25-28.

37. *Ibid.*, pp. 15-17.

38. *Ibid.*, pp. 12-20; Alexander Macomb to Stephen H. Long, March 24, 1826, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77.

39. "Babcock Case," NA, RG 153.

40. *Ibid.*

41. Alexander Macomb to Samuel McKee, May 19, 1826, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77; Alexander Macomb to John Sowers, November 21, and December 10, 1826, *ibid.*; Alexander Macomb to Henry Shreve, December 1, 1826, *ibid.*

42. Alexander Macomb to Henry Shreve, December 1, 1826, *ibid.*; Alexander Macomb to Henry Shreve, April 9, 1827, *ibid.*; Alexander Macomb to John Bruce, April 9, 1827, *ibid.*

43. John Bruce to President Andrew Jackson, February 17, 1831, "Letters Received by the Topographical Bureau of the War Department, 1824-65," NA, RG 77; "Papers Relating to Bruce's Claims against the United States for damages sustained by his boats and other Equipment while working on the Ohio and Mississippi Rivers in 1824, 1825" (70 pages of

legal papers), Claude W. Unger Collection, Historical Society of Pennsylvania, Philadelphia, Pa.; U. S., Congress, Senate, *Report of the Committee of Claims, to Whom was Referred the Petition of John Bruce for Remuneration on Account of Losses on Contract for Removing Obstructions in the Ohio and Mississippi Rivers*, S. Doc. No. 421, 26 Cong., 1 Sess., 1840, *passim*; *Rivers and Harbors Laws*, I, 69.

44. U. S., Congress, House, *Navigation Ohio and Mississippi Rivers*, H. Rept. No. 379, 21 Cong., 1 Sess., 1830, p. 3.

45. *Rivers and Harbors Laws*, I, 40.

CHAPTER IV: FOOTNOTES

1. A discussion of administrative aspects and operation of the Louisville and Portland Canal Company as a public corporation may be consulted in Paul B. Trescott, "The Louisville and Portland Canal Company, 1825-1874," *Mississippi Valley Historical Review*, XLIV (March, 1958), 686-708.

2. Some of the more interesting descriptions of the Falls in their natural state which might be consulted are accounts printed in Harlow Lindley, ed., *Indiana as Seen by Early Travelers*, pp. 30-31, 39-41. An interesting official Army report on the unimproved Falls is "Report on Site of National Armory on the Western Waters," April 24, 1823, in ASP, Class V: *Military Affairs*, II, 734-36.

3. John C. Oakes, "Works at the Falls of the Ohio River, Louisville, Ky.," *Military Engineer*, VI (September-October, 1914), 563-64. Robert R. Jones, long-time Assistant Engineer in Louisville and Cincinnati Engineer Districts, calculated the gradient at 25.25 feet in 1914, after completing a survey; present McAlpine Locks and Dam has a lift of 37 feet to submerge the Falls, provide a navigable depth up to Markland Locks and Dam, and permit the development of hydroelectric power.

4. See descriptions previously cited.

5. The work of Tarascon and Berthold is described in McMurtrie, *Sketches of Louisville and Its Environs*, pp. 160, 162-64; the work of the Falls pilots is mentioned in U. S., Congress, Senate, *Report: The Committee on Roads and Canals, to which was Referred the Bill to Authorize the Purchase of Stock for the United States in the Louisville and Portland Canal Company*, S. Doc. No. 284, 26 Cong., 1 Sess., 1840.

6. Archer B. Hulbert, ed., *Ohio in the Time of the Confederation*, Vol. III of *Ohio Company Series* (Marietta, Ohio: Marietta Historical Commission, 1918), pp. 92-94; Gaillard Hunt, ed., *Journals of the Continental Congress, 1774-1789*, Vol. XXIV (Washington: Government Printing Office, 1922), p. 427.

7. Information about the early canal projects is provided by Paul Fatout, "Canal Agitation at Ohio Falls," *Indiana Magazine of History*, LVII (December, 1961), 279-309; and James Oliver Parker, "A History of the Canal Projects at the Falls of the Ohio River" (unpublished master's thesis, University of Kentucky, 1937). The formation of the Indiana Canal Company and the comments of General Wilkinson are reviewed in *Proceedings of the Managers of the Ohio Canal Company at Louisville on Wednesday, the 11th Day of September, 1805* (pamphlet; Lexington, 1805).

8. "Canal from the Head to the Foot of the Rapids of the Ohio River, communicated to the Senate, January 28, 1805," in ASP, Class X: *Miscellaneous*, I, 419; Thomas T. Davis to President Jefferson, March 17, 1805, in Clarence E. Carter, ed., *The Territorial Papers of the United States*, Vol. VII: *The Territory of Indiana, 1800-1810* (Washington, 1939), p. 272; Isaac J. Cox, "The Burr Conspiracy in Indiana," *Indiana Magazine of History*, XXV (December, 1929), 257-80.

9. *Proceedings of the Managers of the Ohio Canal Com-*

pany at Louisville on Wednesday, the 11th Day of September, 1805, passim; "Canal from the Head to the Foot of the Rapids of the Ohio River," communicated to the House, March 19, 1806, in ASP, Class X: *Miscellaneous*, I, 453-54; Alfred Pirtle, "Early History of the Louisville and Portland Canal" (unpublished 9 page manuscript, Kansas City Federal Record Center, Box NA1045, Folder L. & P. C. 67, NA, RG77), provides biographical information about Brooks. Brooks resigned from the Army in 1802 and moved to Louisville. He edited the *Louisville Gazette* from 1808 to 1810, surveyed and mapped Louisville in 1812, and died in 1816.

10. "Canal from the Head to the Foot of the Rapids of the Ohio River," communicated to the Senate, January 24, 1807, in ASP, Class X: *Miscellaneous*, I, 479; Albert Gallatin's report on "Roads and Canals," April 6, 1808, which includes a copy of the Brooks' map of the Falls, is printed in ASP, Class X: *Miscellaneous*, I, 724-921 (see especially pp. 821-26 and p. 732).

11. U. S., Congress, House, *Canal around the Falls in the Ohio River, Memorial of Citizens of Jeffersonville, Indiana*, H. Ex. Doc. No. 112, 29 Cong., 1 Sess., 1846, pp. 2-3; Charles K. Palmer, "Improvement of Navigation on the Ohio River" (65 page mimeographed study, historical files of Ohio River Division, Corps of Engineers, Cincinnati, Ohio), pp. 39-41; Logan Esarey, "Internal Improvements in Early Indiana," *Indiana Historical Society Publications*, V (1912), 65-69.

12. A general history of the Louisville and Portland Canal is Heber P. Walker, "Louisville and Portland Canal," *Indiana Magazine of History*, XXVIII (March, 1932), 21-30. "Report on Site of National Armory on the Western Waters," April 24, 1823, in ASP, Class V: *Military Affairs*, II, 736, provides information on the work of Baldwin; McMurtrie, *Sketches of Louisville and Its Environs*, pp. 177-78; *Louisville Public Advertiser*, August 4, 1818, quotes the Cincinnati *Western Spy* and prints a reply.

13. McMurtrie, *Sketches of Louisville and Its Environs*, pp. 172-77, 190.

14. "Reconnaissance of the Ohio River above the Falls Made in 1819 by Commissioners Appointed by the States of Virginia, Kentucky, Pennsylvania, and Ohio," November 2, 1819, n. p.; *Niles' Weekly Register*, XVII (December 25, 1819), 287; U. S., Congress, House, *Message from the President of the United States Transmitting a Report of the Board of Engineers on the Ohio and Mississippi Rivers Made in the Year 1821*, H. Ex. Doc. No. 35, 17 Cong., 2 Sess., 1823, pp. 8-10.

15. *Louisville Public Advertiser*, November 3, 1824; Paul B. Trescott, "The Louisville and Portland Canal Company, 1825-1874," *Mississippi Valley Historical Review*, XLIV (March, 1958), 687-89; Kentucky, General Assembly, "Governor's Message Endorsing Resolution of the Legislature of Ohio, on the Subject of a Canal Around the Falls of the Ohio River" (pamphlet, 1824; Filson Club collection), prints the report of Bates and Kelly.

16. *Louisville Public Advertiser*, October 22, 1825. A

biographical sketch of Judge Bates is printed in Charles B. Stuart, *Lives and Works of Civil and Military Engineers of America* (New York, 1871), pp. 91-108.

17. *Louisville Public Advertiser*, October 22, 1825. The best source for the construction history of the canal is Increase Allen Lapham Papers, Manuscript Division, Wisconsin State Historical Society, Madison, Wisconsin. Portions of these papers were printed in Samuel W. Thomas and Eugene H. Conner, eds., "The Falls of the Ohio River and Its Environs: The Journal of Increase Allen Lapham for 1827-1828," *Filson Club History Quarterly*, XLV (1971), 5, 199, 315, 381. Selections were also printed in *Louisville Courier-Journal*, October 30, 1898.

18. *Louisville Public Advertiser*, October 22, 1825, and December 23, 28, 1825. The July 10, August 2, and August 30 issues of *ibid.* provide progress reports.

19. See description of construction methods in Karl Bernhard, *Travels through North America During the Years 1825 and 1826* (2 vols.; Philadelphia, 1828), II, 130-31; Increase A. Lapham Papers, Wisconsin State Historical Society. For origin of "Hoosier," see William E. Wilson, *Indiana: A History* (Bloomington, 1966), p. 13; and Oscar D. Short, "Origin of the Term 'Hoosier,'" *Indiana Magazine of History*, XXV (June, 1929), 101-03.

20. Increase A. Lapham Papers, Wisconsin State Historical Society, provides details and sketches of the machinery.

21. Biographical sketch of White is printed in Charles B. Stuart, *Lives and Works of Civil and Military Engineers of America*, pp. 74-90. On the Louisville cement industry, see "Louisville and Portland Canal," *Family Magazine*, IV (1839), 294-96; Lewis Collins and Richard H. Collins, *History of Kentucky* (2 vols.; Louisville, 1924), II, 363.

22. Alfred Pirtle, "Early History of the Louisville and Portland Canal," pp. 5-6; Increase A. Lapham Papers, Wisconsin State Historical Society. Accounts of dimensions vary in different accounts, but Pirtle and Lapham were engineers and took measurements; hence, their accounts are presumed to be most reliable.

23. Trescott, "The Louisville and Portland Canal Company, 1825-1874," pp. 690-93; U. S., Congress, Senate, *Fifth Annual Report of the President and Directors of the Louisville and Portland Canal Company*, S. Doc. No. 36, 21 Cong., 1 Sess., 1830, pp. 4-5; *Louisville Public Advertiser*, January 17, 1831.

24. *Louisville Public Advertiser*, January 17 and 19, 1831, December 24 and 30, 1830; U. S., Congress, House, *Ohio River - Falls at Louisville*, H. Ex. Doc. No. 95, 32 Cong., 1 Sess., 1852, p. 7. An undated newspaper article, written by Hugh Hays, in Lewis Starling Collection, Manuscript Division, Kentucky Library, Bowling Green, Kentucky, states the opening of the canal was celebrated with "great rejoicing and a general jubilee," but no evidence was discovered to support this in other records. As reported by Captain Cram, the average prices for which work was completed were: rock excavation, \$1.50 per cubic yard; paving slopes, 15¢ per square yard; earth excavation, 15¢ per cubic yard; stone masonry, \$12.37 per perch.

25. *Niles' Weekly Register*, XLVI (March 31, 1832), 82.

26. Pirtle, "Early History of the Louisville and Portland Canal," pp. 6-7.

27. See statistics in Hunter, *Steamboats on Western Rivers*, pp. 183-85; and William E. Connelly and E. M. Coulter, *History of Kentucky* (5 vols.; New York, 1922), II, 726-27, which also quotes Governor Desha of Kentucky.

28. *Nashville National Banner and Nashville Whig*, January 28, 1833; Pirtle, "Early History of the Louisville and Portland Canal," pp. 6-7.

29. Hunter, *Steamboats on Western Rivers*, p. 88; and note by Captain Frederick Way in *S&D Reflector*, IV (September, 1967), p. 23.

30. Trescott, "The Louisville and Portland Canal Company, 1825-1874," pp. 694-95. The complaints to Congress may be examined in Senate Document No. 5, 22 Cong., 2 Sess., 1832; Senate Document No. 6, 23 Cong., 1 Sess., 1833; and House Executive Document No. 11, 23 Cong., 1 Sess., 1833. There were others.

31. U. S., Congress, Senate, *Report: The Committee on Roads and Canals, to Which was Referred the Bill to Authorize the Purchase of Stock for the United States in the Louisville and Portland Canal Company*, S. Doc. No. 284, 26 Cong., 1 Sess., 1840, *passim*; U. S., Congress, House, *Louisville and Portland Canal*, H. Ex. Doc. No. 154, 28 Cong., 1 Sess., 1844, p. 8.

32. See Senate Document 284, 26 Cong., 1 Sess., 1840, cited above.

33. U. S., Congress, House, *Chute - Great Falls of Ohio*, H. Doc. No. 488, 23 Cong., 1 Sess., 1834, *Passim*.

34. U. S., Congress, House, *Site for an Armory - Louisville, Kentucky*, H. Doc. No. 46, 19 Cong., 1 Sess., 1826, *passim*; "Correspondence with Officers of the Louisville and Portland Canal Company relative to a Site for a National Armory," January 18, 1826, in ASP, Class V; *Military Affairs*, III, 188-93.

35. "General Report on an Examination and Survey of Various Sites for the Establishment of an Armory on the Western Waters," May 27, 1830, in ASP, Class V; *Military Affairs*, IV, 470-578. Captain Smith served in the Corps from 1820 to his death in 1858. He especially distinguished himself in action during the Mexican War. His assistant, Lieutenant George Whistler, was "Whistler's Father," that is, he was the father of James Whistler, the artist. During this survey, Captain Smith sought to employ Increase Lapham as an assistant, but Lapham chose to remain at the Louisville canal. The report of 1842 on a site for the national armory is printed in U. S., Congress, House, *Site for a Western Armory*, H. Ex. Doc. No. 133, 27 Cong., 3 Sess., 1843. The armory was eventually constructed at Rock Island, Illinois, on the Upper Mississippi River.

36. Trescott, "The Louisville and Portland Canal Company, 1825-1874," pp. 697-700.

37. *Ibid.*; Heber P. Walker, "Louisville and Portland Canal," pp. 29-30.

38. Trescott, "The Louisville and Portland Canal Company, 1825-1874," pp. 697-700. Despite the numerous articles and papers written about the history of the Louisville and Portland Canal Company, a definite need for a comprehensive history of the canal still exists.

CHAPTER V: FOOTNOTES

1. U. S., Congress, House, *Obstructions in the River Ohio*, H. Doc. No. 213, 20 Cong., 1 Sess., 1828, pp. 1-3.

2. *Rivers and Harbors Laws*, I, 40, 44, 51, 53, 57-59, 64, 67, 71, 75, 81-82, 86.

3. U. S., Congress, Senate, *Message from the President*

of the United States to the Two Houses of Congress, S. Doc. No. 1, 20 Cong., 1 Sess., 1827, p. 58; Charles Gratiot to Peter B. Porter, November 19, 1828, ASP, Class V; *Military Affairs*, IV, 12-17.

4. Remarks of Robert P. Henry to the House, December

28, 1826, in *Register of Debates in Congress*, 19th Congress, 2nd Session, p. 567. The Grand and Little Chains of Rocks in the Ohio River are not to be confused with obstructions with the same name in the Mississippi above Cairo, Illinois. The Little Chain was located in the river below Fort Massac opposite the present site of the village of Joppa, Illinois; the Grand Chain was just below the Little Chain, commencing at the present site of Baccus Landing (Mile 958) and obstructing the channel down to the present site of Lock and Dam No. 53 (Mile 962.6).

5. U. S., Congress, Senate, *Report of the Secretary of War Showing What Progress Has Been Made in Deepening and Clearing the Channel at a Place Called the Grand Chain*, S. Doc. 203, 20 Cong., 1 Sess., 1828, pp. 6-7.

6. *Ibid.*; U. S., Congress, House, *Obstructions - The Ohio River*, H. Rept. No. 269, 20 Cong., 1 Sess., 1828, *passim*; Alexander Macomb to William Courtney, May 14, 1827, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77; Alexander Macomb to Henry M. Shreve, May 14, 1827, *ibid.*; Charles Gratiot to Henry M. Shreve, April 9, 1829, *ibid.*

7. U. S., Congress, Senate, *Report of the Secretary of War Showing What Progress Has Been Made in Deepening and Clearing the Channel at a Place Called the Grand Chain*, S. Doc. No. 203, 20 Cong., 1 Sess., 1828, pp. 1-6; Dorsey, *Master of the Mississippi*, pp. 151-56; Secretary of War John W. Eaton report to the President, December 1, 1830, in ASP, Class V: *Military Affairs*, IV, 585-88.

8. Hunters, *Steamboats on Western Rivers*, pp. 195-96; John L. Smith to Henry M. Shreve, July 23, 1824, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77. Compare with account in Dorsey, *Master of the Mississippi*, pp. 142-43. Dorsey portrays Captain Shreve as a heroic figure fighting navigation monopolies, river obstructions, and an incompetent bureaucracy. She states that OCE did not reply to his suggestion for removing snags, but see the letter of Captain John L. Smith, OCE, cited above.

9. Dorsey, *Master of the Mississippi*, p. 156-61 (letter from Shreve to Chief Engineer Gratiot, October, 1829, quoted on p. 158).

10. U. S., Congress, House, *Letter from Henry M. Shreve to the Hon. C. A. Wickliffe upon the Subject of the Navigation of the Mississippi River*, H. Doc. No. 11, 20 Cong., 1 Sess., 1827, *passim*; U. S., Congress, House, *Obstructions in the River Ohio*, H. Doc. No. 213, 20 Cong., 1 Sess., 1828, *passim*.

11. Alexander Macomb to Henry M. Shreve, December 11, 1827, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77; Engineer Department to Henry M. Shreve, June 27, 1828, *ibid.* The contention of Dorsey, *Master of the Mississippi*, pp. 147-48, that OCE was dilatory in its actions on the subject of the steam snag-boat is not borne out by the records of the Engineer Department. Though the delay in authorizing and funding the construction of a prototype may have seemed excessive to the impatient Captain Shreve, the records of OCE indicate that the matter was handled expeditiously. And in view of the unfortunate results of the Bruce contract it is somewhat surprising that OCE approved the construction of the expensive snag-boat at such an early date.

12. *Louisville Public Advertiser*, May 9, 1829; U. S., Congress, House, *Navigation Ohio and Mississippi Rivers*, H. Rept. No. 379, 21 Cong., 1 Sess., 1830, pp. 3-4; U. S., Congress, House, *Henry M. Shreve-Snag Boat*, H. Rept. No. 272, 27 Cong., 2 Sess., 1843, pp. 9-12; Dorsey, *Master of the Mississippi*, pp. 148-54. Increase A. Lapham, Assistant Engineer at the Louisville and Portland Canal, visited the shipyard on June 4, 1829, saw the *Heliopolis*, and described it: "It consists of two boats about 100 feet long and 12 wide placed about 10 feet apart, and strongly connected

by timbers running across at the bow & stern — each boat contains a very powerful steam engine. The timbers at the bow are covered with sheat [sic] iron on the forward side which is to be applied to the log and the power of the engines is to remove it." Increase A. Lapham Papers, Wisconsin State Historical Society, Madison, Wisconsin.

13. Dorsey, *Master of the Mississippi*, pp. 145-55; Lieutenant Alexander Bowman report to General Charles Gratiot, January 31, 1835, ASP, Class V: *Military Affairs*, V, 691.

14. U. S., Congress, House, *Navigation Ohio and Mississippi Rivers*, H. Rept. No. 379, 21 Cong., 1 Sess., 1830, *passim*; Charles Gratiot to Charles A. Wickliffe, April 14, 1830, "Letters Sent by Office of Chief of Engineers Relating to Internal Improvements, 1824-30," NA, RG 77, is information furnished Congress by OCE in response to the memorial of Louisvillians, and it fully supports the construction of additional snag-boats. See summary of snag-boat construction by Colonel Stephen H. Long printed in U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, p. 208; *Rivers and Harbors Laws*, I, 82 (Congress appropriated \$23,000 on March 3, 1837, to replace the *Archimedes*).

15. U. S., Congress, House, *Ohio and Mississippi Rivers*, H. Ex. Doc. No. 66, 22 Cong., 2 Sess., 1833, *passim*; U. S., Congress, House, *Message from the President of the United States to the Two Houses of Congress*, H. Ex. Doc. No. 2, 22 Cong., 1 Sess., 1831, pp. 90-93. Shreve's work on the Red River is covered in some detail in Dorsey, *Master of the Mississippi*, pp. 164-208.

16. Hunter, *Steamboats on Western Rivers*, pp. 198-99; Henry M. Shreve to Charles Gratiot, September 30, 1833, ASP, Class V: *Military Affairs*, V, 209-11; T. S. Brown to Charles Gratiot, May 8, 1833, *ibid.*, V, 214-17.

17. Hunter, *Steamboats on Western Rivers*, p. 193; Henry M. Shreve to Charles Gratiot, September 30, 1835, ASP, Class V: *Military Affairs*, V, 689; Henry M. Shreve to Charles Gratiot, September 30, 1832, *ibid.*, V, 59.

18. *Rivers and Harbors Laws*, I, 57-58. Act of March 2, 1831, provided for "removing the obstructions in the channel at the shoal places and ripples, and by such other means as may be deemed best for deepening of the channels of the Ohio River."

19. "Richard Delafield," *Professional Memoirs*, III (July-September, 1911), 416-18; Charles N. Branham, ed., *Register of Graduates and Former Cadets, United States Military Academy* (West Point, New York, 1960), p. 174, 179 (cited hereinafter as *Register of Graduates*, USMA); Alexander H. Bowman, *Remarks on Making and Applying Concrete* (Washington, 1849).

20. Dorsey, *Master of the Mississippi*, p. 179; Henry M. Shreve to Charles Gratiot, September 30, 1832, ASP, Class V: *Military Affairs*, V, 58-60.

21. Henry M. Shreve to Charles Gratiot, September 30, 1832, ASP, Class V: *Military Affairs*, V, 58-60; Henry M. Shreve to Charles Gratiot, September 30, 1833, *ibid.*, V, 209-11; Alexander H. Bowman to Charles Gratiot, October 24, 1834, *ibid.*, V, 410-13. A related discussion is provided in Leland R. Johnson, "Army Engineers on the Cumberland and Tennessee, 1824-1854," *Tennessee Historical Quarterly*, XXXI (Summer, 1972), pp. 155-56. The author visited Cumberland Dam during the ground-breaking ceremonies for Smithland Locks and Dam, September 25, 1971.

22. S. Goodwin (by order of directors and president of Louisville and Portland Canal Company) to President Andrew Jackson, June 6, 1831, (C. 434 De Grange listing), NA, RG 77. An indorsement on the reverse of this letter states it was presented to Jackson on June 29, who stated the business had been attended to and Captain Shreve directed to divide his force and operate above and below the Falls.

This is confusing, for no orders for Shreve to do so have been located, and no operations above the Falls ensued. It is believed that the indorsement was in error; that Shreve was instructed *not* to divide his force. Shreve wrote in 1834: "In relation to the improvement of the bars on the Ohio river by wing dams, there can no longer be a doubt of the great benefits already produced by those built. And should that system of improvement be proceeded with by the government, there can be no doubt of obtaining four feet of water at its lowest stage from the Mississippi to the falls in the Ohio, and from Louisville to the mouth of the Ohio canal, at Portsmouth; and from then to Pittsburgh, three feet six inches may be obtained by the same system of improvement." Henry M. Shreve to Charles Gratiot, October 30, 1834, ASP, Class V: *Military Affairs*, V, 413-14.

23. *Rivers and Harbors Laws*, I, 71; George Dutton to Charles Gratiot, October 25, 1835, ASP, Class V: *Military Affairs*, V, 693-96; U. S. Congress, House, *Cumberland Road and Ohio River*, H. Ex. Doc. No. 52, 24 Cong., 2 Sess., 1836, pp. 38-41.

24. See note 23.

25. James St. Clair Morton, *Memoir of the Life and Services of Capt. and Brevet Major John Sanders* (Pittsburgh; W. S. Haven, 1861), pp. 43-60. This rare pamphlet was written by an Engineer officer who knew Sanders well. For some reason, Morton's biography of Sanders is sprinkled with attacks on the United States Military Academy; he claimed Sanders' achievements as an engineer were accomplished in spite of his training at West Point. The biography is cited hereinafter as Morton, *Sanders*.

26. Morton, *Sanders*, pp. 9-13; John Sanders to Charles Gratiot, November 4, 1837, ASP, Class V: *Military Affairs*, VII, 690. W. Milnor Roberts began the survey of 1867 at the point where Sanders' survey had ended. Portions of the uppermost section of the river were resurveyed near the end of the nineteenth century for the slackwater project, but Sanders' survey was not completely superceded until the survey of 1911-14 was completed under the direction of General Lytle Brown and Robert R. Jones, Assistant Engineer.

27. U. S., Congress, House, *Message from the President of the United States to the Two Houses of Congress*, H. Ex. Doc. No. 2, 25 Cong., 3 Sess., 1838, pp. 317-38; Morton, *Sanders*, pp. 9-10.

28. U. S., Congress, Senate, *Report on the Improvements of the Falls of the Ohio River*, S. Doc. No. 530, 26 Cong., 1 Sess., 1840, *passim*.

29. Morton, *Sanders*, pp. 16-17; U. S., Congress, Senate, *Message from the President of the United States to the Two*

Houses of Congress, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, p. 215.

30. John Sanders to Charles Gratiot, November 4, 1837, ASP, Class V: *Military Affairs*, VII, 689-92; *Rivers and Harbors Laws*, I, 57-58, 71, 75, 81, 86.

31. Andrew Jackson to Amos Kendall, July 23, 1832, in John S. Bassett, ed., *Correspondence of Andrew Jackson* (7 vols.; Washington, 1926-35), IV, 465; Andrew Jackson to Martin Van Buren, October 18, 1830, in *ibid.*, pp. 185-86; Carlton Jackson, "The Internal Improvement Vetoes of Andrew Jackson," *Tennessee Historical Quarterly*, XXV (Fall, 1966), 277; Edward L. Pross, "A History of Rivers and Harbors Appropriation Bills, 1866-1933" (unpublished Ph.D. dissertation, Ohio State University, 1938), p. 23. An editorial on Jackson's position is printed in *Louisville Public Advertiser*, January 13, 1831. Jackson's opinion of the Corps of Engineers is revealed in Andrew Jackson to John C. Calhoun, August 9, 1920, in W. Edwin Hemphill, ed., *The Papers of John C. Calhoun*, V (Columbia, S. C., 1971), 317-19.

32. U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 25 Cong., 3 Sess., 1839, I, 107 (see also Sen. Doc. No. 58, 26 Cong., 1 Sess., 1840, pp. 10-12). For further information about Van Buren's policies, see Joseph H. Harrison, Jr., "Martin Van Buren and His Southern Supporters," *Journal of Southern History*, XXII (November, 1956), 438-58.

33. U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 26 Cong., 1 Sess., 1839, pp. 193-96 (see also Senate Doc. No. 1, 26 Cong., 2 Sess., 1840, p. 120).

34. Douglas S. Freeman, *R. E. Lee: A Biography* (4 vols.; New York, 1934-35), I, 140; U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 26 Cong., 2 Sess., 1840, pp. 122-26.

35. Dorsey, *Master of the Mississippi*, pp. 206-07; U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 26 Cong., Sess. 1840, pp. 120-22.

36. U. S., Congress, House, *Henry M. Shreve - Snag-Boat*, H. Rept. No. 272, 27 Cong., 3 Sess., 1843 *passim*; U. S., Congress, House, Committee on Patents, *Henry M. Shreve*, H. Rept. No. 369, 29 Cong., 1 Sess., 1846, *passim*; *Rivers and Harbors Laws*, I, 332.

37. Dorsey, *Master of the Mississippi*, pp. 206-20, 248, 260.

CHAPTER VI: FOOTNOTES

1. Pross, "A History of Rivers Appropriation Bills, 1866-1933," pp. 25-41; Albjerg, "Internal Improvements without a Policy," pp. 176-77.

2. U. S., Congress, House, *Memorial of Citizens of the City of Cincinnati, Relative to the Improvement of the Navigation of the Ohio and Mississippi Rivers*, H. Doc. No. 126, 27 Cong., 3 Sess., 1843, *passim*.

3. U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 27 Cong., 3 Sess., 1842, I, 10; *Rivers and Harbors Laws*, I, 96, 98, 100.

4. U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, pp. 208-09; *Louisville Journal*, December 14, 1841.

5. Ella H. Ellwanger, "Famous Steamboats and Their

Captains on Western and Southern Waters," *Register of Kentucky State Historical Society*, XVIII (January, 1920), 21-29.

6. U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 27 Cong., 3 Sess., 1842, pp. 285-86; John W. Russell to Topographical Bureau, March 31, April 15, June 4, August 30, September 19, October 10, November 27, December 30, 1842, and February 2, April 26, July 10, 1843, in "Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77.

7. U. S., Congress, House, *Survey of the Ohio River*, H. Doc. No. 50, 27 Cong., 3 Sess., 1843, *passim*; George W. Hughes to Topographical Bureau, October 10, 12, 16, 24, 27, 1842, January 5, February 13, 1843, in "Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77.

8. Wood, *Long*, pp. 189-206; Stephen H. Long to Topo-

graphical Bureau, March 2, April 26, April 27, May 10, 15, 19, June 1, 1843, in "Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77; Stephen H. Long to J. J. Abert, April 26, 1843, in "Letters and Reports Sent by the Office of Improvements on the Western Rivers," NA, RG 77.

9. U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, pp. 213-14; *ibid.*, 28 Cong., 2 Sess., 1844, pp. 274-79.

10. Stephen H. Long to J. J. Abert, December 20, 1853, in "Letters and Reports Sent by the Office of Improvements on the Western Rivers," NA, RG 77.

11. Stephen H. Long to J. J. Abert, April 14 and 24, 1848, in "Letters and Reports Sent by the Office of Improvements on the Western Rivers," NA, RG 77; U. S., Congress, House, *Message from the President to the Two Houses of Congress*, H. Ex. Doc. No. 2, 29 Cong., 1 Sess., 1845, pp. 348-49.

12. Campbell Graham to Topographical Bureau, December 7, 1842, March 21, 28, 1843, in "Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77; Morton, *Sanders*, pp. 17-18; J. J. Abert to Joseph Totten, March 2, 1843, in "Register of Letters Received by Office of Ohio River Improvement, 1835-1845," NA, RG 77.

13. U. S., Congress, Senate, *Message from the President to the Two Houses of Congress*, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, pp. 182-83.

14. Stephen H. Long to Topographical Bureau, April 25, 29, May 11, 1844, in "Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77; *Haldeman's Directory for Louisville for 1844-1845*, p. 293.

15. John Sanders to Topographical Bureau, July 16, 1844, in "Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77; U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, p. 220; *ibid.*, 28 Cong., 2 Sess., 1844, pp. 270-71.

16. Hunter, *Steamboats on Western Rivers*, p. 204; U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, pp. 216-20.

17. See citations in note 16 and Morton, *Sanders*, pp. 13-14.

18. Albjerg, "Internal Improvements without a Policy," p. 176; Gould, *Fifty Years on the Mississippi*, p. 290; Eugene I. McCormac, *James K. Polk: A Political Biography* (2nd ed., New York, 1965), pp. 678-80; *Cincinnati Gazette*, October 2, 1846, as quoted in Hunter, *Steamboats on Western Rivers*, p. 191.

19. James W. Abert to James Taylor, June 2, 1852, in James Taylor Papers, Filson Club, Louisville, Kentucky; U. S., Congress, House, *Message from the President to the Two Houses of Congress*, H. Ex. Doc. No. 2, 29 Cong., 1 Sess., 1845, p. 298. See similar comments by Abert in U. S., Congress, House, *Mississippi River and Tributaries*, H. Doc. No. 153, 28 Cong., 1 Sess., 1844, p. 2.

20. U. S., Congress, House, *Message from the President to the Two Houses of Congress*, H. Ex. Doc. No. 2, 29 Cong., 1 Sess., 1845, pp. 348-58; Stephen H. Long to J. J. Abert, May 26, 1846, "Letters and Reports Sent by the Office of Improvements on the Western Rivers," NA, RG 77. Allan Campbell completed the first railroad in South America, was again employed by the Engineers on New York harbor defenses during the Civil War, became chief of construction on the Union Pacific Railroad, and at the end of his career served as Commissioner of Public Works and Comptroller for New York City. See obit. in *Engineering News*, XXXI (March 22, 1894), 237.

21. Morton, *Sanders*, pp. 18-27; U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Doc. No. 1, 28 Cong., 1 Sess., 1843, p. 223.

22. Morton, *Sanders*, pp. 28-29.

23. Hunter, *Steamboats on Western Rivers*, p. 553; for a listing of steamboats employed by the Army during the Mexican War, see U. S., Congress, Senate, *Report of the Secretary of War Showing the Contracts Made Under the Authority of that Department during the Year 1848*, S. Ex. doc. No. 17, 30 Cong., 2 Sess., 1849, pp. 23-96. Stephen H. Long to Topographical Bureau, August 8, October 12, 1846, in "Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77; U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, H. Ex. Doc. No. 8, 30 Cong., 1 Sess., 1848, pp. 670-78; informational note in *SCD Reflector*, IV (December, 1966), 22-23; Wood, *Long*, pp. 211-17.

24. U. S., Congress, House, *Message from the President to the Two Houses of Congress*, H. Ex. Doc. No. 1, 30 Cong., 2 Sess., 1848, p. 324.

25. *Ibid.*, H. Ex. Doc. No. 5, 31 Cong., 1 Sess., 1849, pp. 335-43; U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Ex. Doc. No. 1, 32 Cong., 1 Sess., 1851, p. 428, quotes Colonel Long: "The important works under this head have languished another year, for want of appropriations."

26. Stephen H. Long to James W. Abert, March 7, 1847, in "Letters and Reports Sent by the Office of Improvements of the Western Rivers," NA, RG 77; James W. Abert to Stephen H. Long, March 7, 1847, in *ibid.*; Stephen H. Long to J. J. Abert, March 7, 1847, in *ibid.* James W. Abert ranked 55th in the class of 1842 at the Military Academy, he married the daughter of Colonel James Taylor of Louisville. See *Register of Graduates, USMA*, p. 193, and the Abert Correspondence with James Taylor in James Taylor Papers, Filson Club, Louisville, Kentucky.

27. Wood, *Long*, pp. 219-32; Hunter, *Steamboats on Western Rivers*, pp. 462-64; Richard G. Wood, "Construction of the Louisville and Paducah Marine Hospitals," *Register of Kentucky Historical Society*, LVI (January, 1959), 27-32; *ibid.*, "The Marine Hospital at Napoleon," *Arkansas Historical Quarterly*, XIV (Spring, 1955), 38-42.

28. U. S., Congress, House, *Memorial from a Meeting of Citizens of the West, Held at Evansville, Indiana, on the Subject of Western Interests*, H. Misc. Doc. No. 3, 31 Cong., 2 Sess., 1850, *passim*; U. S., Congress, Senate, *Message from the President to the Two Houses of Congress*, S. Ex. Doc. No. 1, 32 Cong., 1 Sess., 1851, p. 18.

29. *Rivers and Harbors Laws*, I, 119-24; see lengthy debate over constitutional issues in *Congressional Globe*, 32 Cong., 1 Sess., XXV, 827-32, 863-75. U. S., Congress, Senate, *Message from the President to the Two Houses of Congress*, S. Doc. No. 1, 33 Cong., 1 Sess., 1853, pp. 29-53, 80-83, 86-92.

30. Pross, "A History of Rivers and Harbors Appropriation Bills, 1866-1933," pp. 36-39; *Rivers and Harbors Laws*, I, 131-36; Roy Nichols, *Franklin Pierce: Young Hickory of the Granite Hills* (Philadelphia, 1958), 354-55, 374-75; U. S., Congress, Senate, *Message from the President to the Two Houses of Congress*, S. Doc. No. 1, 33 Cong., 1 Sess., 1853, pp. 25-29.

31. John W. Russell to General Armstrong, February 3, 1853, in "Letters Received by the Topographical Bureau, 1824-65," NA, RG 77; Wood, *Long*, pp. 236-40; Jefferson Davis to Stephen H. Long, September 14, 1853, in "Letters and Reports Sent by the Office of Improvements of the Western Rivers," NA, RG 77; Stephen H. Long to Jefferson Davis, September 20, 1853, *ibid.*; Jefferson Davis to Stephen H. Long, September 29, 1853, *ibid.*; Stephen H. Long to Topographical Bureau, November 1, December 20, 1853, in "Register of Letters received by Topographical Bureau, 1824-66," NA, RG 77.

32. Stuart, *Lives and Works of Civil and Military Engineers of America*, pp. 257-85, provides a biography of Ellet; Charles Ellet, Jr., to Topographical Bureau, June 15, 1849, in

"Registers of Letters Received by Topographical Bureau, 1824-66," NA, RG 77; U. S., Congress, Senate, *Report of the Select Committee on the Memorial of Charles Ellet, Jr., S. Doc. No. 191, 31 Cong., 1 Sess., 1850, passim.*

33. U. S., Congress, Senate, *Improvement of Ohio River*, S. Rept. No. 319, 34 Cong., 3 Sess., 1857, p. 6; Ellwood Morris, *Treatise on the Improvement of the Ohio River* (Pottsville, Pa., 1857), *passim*; Thomas P. Roberts, "Floods and Means of Their Prevention in our Western Rivers," *Proceedings of Engineers' Society of Western Pennsylvania*, XXIII (July, 1907), 315. Charles Ellet explained his theories in two pamphlets: *The Mississippi and Ohio Rivers* (Philadelphia, 1853); and *Report on the Improvement of the Kanawha and Incidentally of the Ohio River, by Means of Artificial Lakes* (Philadelphia, 1858).

34. Biographies and discussions of W. Milnor Roberts' work may be located in "William Milnor Roberts, Civil Engineer," *Engineering News*, V (January 11, 1879), 9-10; John Bogart, "William Milnor Roberts, Past-President, ASCE," *Transactions of the American Society of Civil Engineers*, XXXVI (December, 1896), 531-37; Robert R. Jones, "The Ohio River: A brief account of the considerations which led to the present project for its Canalization" (unpublished 30 page manuscript, Cincinnati, March 27, 1922, in Kansas City Federal Records Center, Box NA1141, Folder Ohio 450, NA, RG 77).

35. Pittsburgh Board of Trade, *Letters to the Pittsburgh Board of Trade on the improvement of the Ohio River by Josiah Copley* (pamphlet; Pittsburgh, 1856), *passim*; Jones, "The Ohio River: A brief account . . .," pp. 12-13; U. S., Congress, Senate, *Improvement of Ohio River*, S. Rept. No. 319, 34 Cong., 3 Sess., 1857, p. 5.

36. Herman Haupt, *A Consideration of the Plans Proposed for the Improvement of the Ohio River* (pamphlet; Philadelphia, 1855), *passim*; U. S., Congress, Senate, *Improvement of Ohio River*, S. Rept. No. 319, 34 Cong., 3 Sess., 1857, p. 9.

37. U. S., Congress, House, *Falls of the Ohio*, H. Rept. No. 661, 29 Cong., 1 Sess., 1846, pp. 1-2.

38. U. S., Congress, House, *Ohio River-Falls at Louisville*, H. Ex. Doc. No. 95, 32 Cong., 1 Sess., 1852, *passim*; *ibid.*, Senate, *Report of Captain T. J. Cram on the Best Mode of Improving the Navigation of the Ohio at the Falls at Louisville*, S. Doc. No. 243, 28 Cong., 1 Sess., 1844, *passim*; U. S., Congress, House, *Falls of the Ohio*, H. Rept. No. 661, 29 Cong., 1 Sess., 1846, pp. 1-16; *Haldeman's Picture of Louisville, Directory and Business Advertiser for 1844-1845* (Louisville, 1844), p. 63. Lieutenant James W. Abert wrote James Taylor, February 18, 1852, that a dam below the Falls would need a crest 37 feet above the mitre sill of the Canal and would forever ruin natural navigation; in James Taylor

Papers, Filson Club, Louisville, Kentucky.

39. Salmon P. Chase, *Improvement of Navigation of the Falls of the Ohio: May 1851* (pamphlet; Cincinnati, 1851), *passim*; *Rivers and Harbors Laws*, I, 123; Stephen H. Long to J. J. Abert, February 14, 1853, incloses "Proceedings of a Board of Topo. Engineers Convened at Louisville, Ky in 1852 to consider imp. Falls Ohio," in "Letters Received by Topographical Bureau, 1824-1865," NA, RG 77 (official report of Board later printed as S. Doc. No. 42, 32 Cong., 2 Sess.).

40. Long proposed the construction of a single lock, 360 by 75 feet, with a 25-foot lift, and widening the canal to 100 feet. The engineers later employed by the company adopted a two-flight, rather than single, lock. See full report of Long in U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Ex. Doc. No. 11, 35 Cong., 1 Sess., 1858, pp. 315-19. Trescott, "The Louisville and Portland Canal Company, 1825-1874," pp. 702-04. Actual construction of the enlarged canal is reviewed in Chapter VIII, *infra*.

41. U. S., Congress, Senate, *Message from the President to the Two Houses of Congress*, S. Ex. Doc. No. 11, 35 Cong., 1 Sess., 1858, pp. 283, 297. Discussions of snag removal, commercial developments on the waterways, and accident statistics are provided in Albert E. Cowdrey, *The Delta Engineers: A History of the U. S. Army Corps of Engineers in the New Orleans District* (New Orleans, 1971), pp. 11-12; U. S., Congress, House, *Message from the President of the United States to the Two Houses of Congress*, H. Ex. Doc. No. 1, 34 Cong., 1 Sess., 1856, pp. 353-65; Ambler, *Transportation in Ohio Valley*, pp. 185-207; Isaac Lippincott, *A History of Manufactures in the Ohio Valley to the Year 1860* (New York, 1914), p. 642.

42. U. S., Congress, Senate, *Message from the President of the United States to the Two Houses of Congress*, S. Ex. Doc. No. 11, 35 Cong., 1 Sess., 1858, p. 1046.

43. *Ibid.*, pp. 303-04, 314-15; *ibid.*, S. Ex. Doc. No. 1, 35 Cong., 2 Sess., 1858, p. 1046.

44. Samuel Cooper to James W. Abert, May 15, 1858, in "Letters and Reports Sent by the Office of Improvement of the Western Rivers," NA, RG 77; James W. Abert to J. J. Abert, June 1, 1858, and September, 1859, *ibid.*

45. Secretary of War to J. J. Abert, October 21, 1859, *ibid.*; J. J. Abert to Secretary of War, October 24, 1859, *ibid.*; J. J. Abert to James W. Abert, January 17, 1860, *ibid.*; Samuel Cooper to James W. Abert, March 8, 1860, *ibid.* James W. Abert retired in 1864 and died at Louisville in 1879. It is suspected that he was a confidential observer of the activities of the canal company on behalf of the principal stockholder, the United States, during his service at Louisville in 1858-59.

CHAPTER VII: FOOTNOTES

1. William G. Eidson, "Louisville, Kentucky, During the First Year of the Civil War," *Filson Club History Quarterly*, XXXVIII (1964), 224-38; Carl Vitz, "Cincinnati: Civil War Port," *Museum Echoes*, XXXIV (July, 1961), 51-54.

2. Ambler, *Transportation in Ohio Valley*, pp. 237-46.

3. U. S., Congress, Senate, *Message from the President to the Two Houses of Congress*, S. Ex. Doc. No. 1, 37 Cong., 2 Sess., 1861, pp. 508-10.

4. U. S., War Department, *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies* (70 vols. in 128, Washington, 1880-1901), Ser. I, LII, Pt. 1, p. 164. (This collection cited hereinafter as *O.R.*, always Series I unless otherwise indicated.) For a list of steamboats purchased or hired by the United States and

those sunk in action consult U. S., Congress, House, *Vessels Bought, Sold, and Chartered by the United States*, H. Ex. Doc. No. 337, 40 Cong., 2 Sess., 1868.

5. The official account of the incident at Paducah is printed in *O.R.*, IV, 176-78. A discussion of the incident and the imposition of a property tax on the citizens of Paducah after the war to reimburse the owners of the *Sam Orr* is provided in Fred Way, "How Come?" *S&D Reflector*, VIII (March, 1971), 28-30.

6. Ambler, *Transportation in Ohio Valley*, pp. 248-56; Hunter, *Steamboats on Western Rivers*, pp. 547-51.

7. Ambler, *Transportation in Ohio Valley*, pp. 259-62; Daniel W. Snapp, "Evansville's Channels of Trade and the Secession Movement, 1850-1865," *Indiana Historical So-*

ciety Publications, VIII (1928), 334-40; William E. Connelley and E. M. Coulter, *History of Kentucky* (5 vols.; New York, 1922), II, 882-83.

8. Connelley and Coulter, *History of Kentucky*, II, 880.

9. Helen B. Crocker, "Green River Steamboating: A Cultural History, 1828-1931" (unpublished master's thesis, Western Kentucky University, 1970), p. 65; *Louisville Journal*, September 11, 30, October 1, 2, 3, 8, 17, 1861. Congressman William H. Wadsworth is quoted in the October 3 issue.

10. Milford M. Miller, "Evansville Steamboats During the Civil War," *Indiana Magazine of History*, XXXVII (December, 1941), 369; Edward M. Coffman, "Captain Thomas Henry Hines and His February, 1863, Raid," *Register of Kentucky State Historical Society*, LV (April, 1957), 105-08; John W. Coleman, *Steamboats on the Kentucky River* (pamphlet; Lexington, 1960), pp. 29-31.

11. Sketches of Engineer activities during the Civil War are Philip M. Thienel, "Engineers in the Union Army, 1861-1865," *Military Engineer*, XLVII (January-February, March-April, 1955), 36-41, 110-15; William M. Robinson, Jr., "The Confederate Engineers," *Military Engineer*, XXII (July-August, September-October, November-December, 1930), 297-305, 410-19, 512-17; James L. Nichols, *Confederate Engineers* (Tuscaloosa, Ala., 1957), *Confederate Centennial Studies*, No. 5; George T. Ness, Jr., "Army Engineers of the Civil War," *Military Engineer*, LVII (January-February, 1965), 38-40.

12. Philip M. Thienel, "The Longest Floating Bridge," *Military Engineer*, XLIX (March-April, 1957), 120-21; *Harper's Weekly*, October 26, 1861; *Louisville Journal*, September 26, 1861.

13. Thienel, "The Longest Floating Bridge," pp. 120-21.

14. William E. Merrill, "The Engineer Service in the Army of the Cumberland," in Thomas B. Van Horn, *History of the Army of the Cumberland: Its Organizations, Campaigns, and Battles*, Vol. II (Cincinnati, 1875), 439-54.

15. James H. Simpson to Richard Delafield, November 15, 1864, in O.R., XXXIX, Pt. 3, 775-76; James H. Simpson to Richard Delafield, June 24, 1865, in Engineer Department, "Letters Received, 1865 (No. S9581)," NA, RG 77.

16. C. F. Smith to Adj. General, November 6, 1861, in O.R., IV, 339-40.

17. A history of the defense of Louisville in 1862 is Charles K. Messmer, "Louisville and the Confederate Invasion of 1862," *Register of Kentucky State Historical Society*, LV (October, 1957), 299-306. General P. G. T. Beauregard is quoted as advocating destruction of the canal in *ibid.*

18. *Ibid.*

19. A complete history of fortification construction under his direction was written by Colonel Simpson in his letter to General Delafield, June 24, 1865, in Engineer Department, "Letters Received, 1865 (S.9581)," NA, RG 77.

20. *Ibid.* Fortifications were named for Union officers killed in action. General James St. Clair Morton and General James B. McPherson, as examples, were Union Engineer officers who died before Petersburg and Atlanta in 1864.

21. *Ibid.*

22. *Ibid.* Details of the program to construct blockhouses for railroad bridge defense are provided in Leland R. Johnson, "Civil War Railroad Defenses," *Tennessee Valley Historical Review*, II (Summer, 1972), 20-26.

23. U. S., War Department, *Report of the Secretary of War, with Accompanying Papers* (Washington, 1866), pp. 102-03; Russell F. Weigley, *Quartermaster General of the Union Army: A Biography of M. C. Meigs* (New York, 1959), pp. 330-33, 346; George B. Nicholson, "John Roberts Gilliss, M. ASCE," *Transactions of American Society of Civil Engineers*, XXXVI (December, 1896), 555-56; Samuel

Whinery, "George Benson Nicholson, M. ASCE," *Transactions of American Society of Civil Engineers*, LIX (December, 1897), 556-61.

24. U. S., Congress, House, *Message from the President of the United States to the Two Houses of Congress*, H. Ex. Doc. No. 1, 39 Cong., 1 Sess., 1865, I, 212-16.

25. *Ibid.*, p. 225; James P. Jones, "Farewell to Arms: Union Troops Muster Out at Louisville, June-August, 1865," *Filson Club History Quarterly*, XXXVI (1962), 272-82.

26. U. S., War Department, *Report of the Secretary of War, with Accompanying Papers* [for 1866], p. 112; Hunter, *Steamboats on Western Rivers*, p. 559; U. S., Congress, House, *Message from the President of the United States to the Two Houses of Congress*, H. Ex. Doc. No. 1, 39 Cong., 1 Sess., 1865, I, 215-16.

27. Carlton Jackson, *Presidential Vetoes, 1792-1945* (Athens, Ga., 1967), pp. 148, 162-64; Pross, "A History of Rivers and Harbors Appropriation Bills, 1866-1933," pp. 43-89; L. Y. Schermerhorn, "The Rise and Progress of River and Harbor Improvements in the U. S.," *Engineering News*, XXXIII (May 30, 1895), 359-60.

28. *Rivers and Harbors Laws*, I, 151-56; U. S., Congress, House, *Report of Chief Engineer for 1866*, H. Ex. Doc. No. 18, 39 Cong., 2 Sess., 1866, p. 4.

29. U. S., War Department, Corps of Engineers, *Annual Report of the Chief of Engineers for 1867* (Washington, 1868), pp. 376-78. Prior to 1867 the annual report of the Chief of Engineers, the most important source for the history of the Corps of Engineers, was printed in various government documents, usually accompanying the President's annual message to Congress. Beginning in 1867 the *Annual Report of the Chief of Engineers* was separately printed and bound and the series has since continued. Published at the end of each fiscal year (currently there is a time lag of 18 to 24 months), the title and format of the series has varied slightly from time to time, but it is commonly known as the *Annual Report of the Chief of Engineers*. Hereinafter it will be cited as ARCE followed by the fiscal year upon which the report was made. The use of *ibidem* is a source of confusion when citing this series and will be dispensed with in this case, and, though the annual report is multivolume, the pages are numbered consecutively in each report until 1953; therefore, volume numbers will not be given until reports subsequent to 1953 are cited.

30. ARCE, 1867, pp. 376-95.

31. ARCE, 1868, pp. 590-91; *Louisville Daily Journal*, May 22, 1867; ARCE, 1869, pp. 291-94.

32. ARCE, 1868, pp. 591-92.

33. ARCE, 1870, pp. 65-66; ARCE, 1871, p. 307.

34. Richard Delafield to E. M. Stanton, August 2, 1866, in Engineer Department, "Letters Sent, 1866 (SW100)," NA, RG 77; W. M. Roberts to Chief of Engineers, August 16, 1866, in Engineer Department, "Registers of Letters Received, 1866-70," *ibid.* Biographical sketches of W. Milnor Roberts may be located in *Engineering News*, V (January 11, 1879), 9-10; and John Bogart, "William Milnor Roberts, Past-President, ASCE," *Transactions of American Society of Civil Engineers*, XXXVI (December, 1896), 531-37.

35. U. S., Congress, House, *River and Harbor Improvements*, H. Ex. Doc. No. 56, 39 Cong., 2 Sess., 1867, pp. 243-44, 261.

36. *Ibid.*, pp. 322-23.

37. ARCE, 1867, pp. 401-02.

38. Ambler, *Transportation in Ohio Valley*, pp. 295-303; Hunter, *Steamboats on Western Rivers*, pp. 569-70; Pittsburgh Board of Trade, *Letters to the Pittsburgh Board of Trade on the Improvement of the Ohio River by Josiah Copley*, pp. 11-12; ARCE, 1871, p. 449.

39. Ambler, *Transportation in Ohio Valley*, pp. 303-06;

Hunter, *Steamboats on Western River*, pp. 569-70; ARCE, 1871, pp. 398-400; U. S., Congress, House, *River and Harbor Improvements*, H. Ex. Doc. No. 56, 39 Cong., 2 Sess., 1867, pp. 262-63; Arthur E. Hopkins, "Steamboats at

Louisville and on the Ohio and Mississippi Rivers," *Filson Club History Quarterly*, XVII (July, 1943), 160-61; James Parton, "Pittsburgh," *Atlantic Monthly*, XXI (January, 1868), 25.

CHAPTER VIII: FOOTNOTES

1. ARCE, 1869, pp. 277-79; ARCE, 1872, p. 459; Louisville *Courier-Journal*, February 29, 1872.
2. ARCE, 1878, pp. 776-79; Louisville *Courier-Journal*, February 29, 1872.
3. Connelley and Coulter, *History of Kentucky*, II, 945-46; Ozro J. Dodds, *Louisville and Portland Canal: Speech of Hon. Ozro J. Dodds of Ohio, in the House of Representatives, February 22, 1873* (Pamphlet; Washington, 1873), p. 14.
4. U. S., Congress, House, *River and Harbor Improvements*, H. Ex. Doc. No. 56, 39 Cong., 2 Sess., 1869, pp. 317-18.
5. *Rivers and Harbors Laws*, I, 167; ARCE, 1867, pp. 38-39.
6. James H. England, "Godfrey Weitzel," *Professional Memoirs*, X (September-October, 1918), 747-50.
7. ARCE, 1868, pp. 528-555.
8. ARCE, 1868, p. 538; see also general comments on improvement of Ohio River on p. 533.
9. ARCE, 1868, p. 538; ARCE, 1873, pp. 529-30; U. S., Congress, House, *Ship Canal around the Falls of the Ohio River*, H. Ex. Doc. No. 181, 40 Cong., 2 Sess., 1868, *passim*.
10. *Rivers and Harbors Laws*, I, 174; Cincinnati Board of Trade, *Report of the Committee on River Navigation of the Board of Trade of Cincinnati, on the Enlargement of the Louisville Canal and the Bridging of the Ohio River* (pamphlet; Cincinnati, 1870), *passim*; Louisville *Courier-Journal*, February 29, 1872. See also General Weitzel's reports in ARCE for fiscal years 1869-1872.
11. ARCE, 1871, p. 461; ARCE, 1872, pp. 442-46, 452-59. One of the works acquired and translated from German by General Weitzel was printed by OCE: Godfrey Weitzel, *Lock-Gates. Translation of [Hancke's] Notes Accompanying Drawings Concerning Construction of Iron Lock-Gates for Harbors of Weser River, Germany* (pamphlet; Washington, 1873).
12. ARCE, 1872, pp. 458-59; Louisville *Courier-Journal*, February 27 and 29, 1872.
13. *Rivers and Harbors Laws*, I, 204-05; ARCE, 1873, pp. 536-37. Toll receipts at the Louisville canal, 1831 to 1872, were:

1831	\$ 12,750.77	1852	\$153,758.12
1832	25,706.12	1853	178,869.39
1833	60,736.92	1854	149,640.43
1834	61,848.17	1855	94,356.19
1835	80,165.24	1856	75,791.85
1836	88,343.23	1857	110,015.38
1837	145,424.69	1858	75,459.21
1838	121,107.16	1859	90,905.63
1839	180,364.01	1860	131,917.15
1840	134,904.55	1861	42,650.02
1841	113,944.59	1862	69,936.90
1842	95,005.10	1863	152,937.02
1843	107,274.65	1864	164,476.26
1844	140,389.97	1865	175,515.49
1845	138,291.17	1866	180,925.40
1846	149,401.84	1867	114,961.35
1847	139,900.72	1868	155,495.88
1848	158,067.96	1869	167,171.60
1849	129,953.46	1870	139,175.00
1850	115,707.88	1871	159,838.90
1851	167,066.49	1872	207,025.19

14. ARCE, 1872, pp. 444-52.
15. U. S., Congress, Senate, *Report of the Select Committee on Transportation-Routes to the Seaboard*, S. Rept. No. 307, 43 Cong., 1 Sess., 1874, p. 544; Louisville *Courier-Journal*, July 13, 1872.
16. ARCE, 1873, pp. 530-35; *Rivers and Harbors Laws*, I, 215, 222-24; ARCE, 1875, p. 778.
17. ARCE, 1878, p. 781; U. S., Congress, House, Committee on Railways and Canals, *Tolls on the Louisville and Portland Canal*, H. Rept., No. 348, 46 Cong., 2 Sess., 1880, *passim*.
18. *Rivers and Harbors Laws*, I, 306; Louisville *Courier-Journal*, July 3, 1880.
19. Godfrey Weitzel to S. F. Covington, January 7, 1881, in General Godfrey Weitzel Letterbooks, Manuscript Division, Cincinnati Historical Society, Cincinnati, Ohio; *Rivers and Harbors Laws*, I, 346-47.
20. ARCE, 1874, pp. 566-69; ARCE, 1873, p. 538; ARCE, 1875, pp. 776-82; ARCE, 1878, p. 783.
21. ARCE, 1868, pp. 534-35; ARCE, 1869, pp. 273-77; ARCE, 1870, pp. 63-64, 385; ARCE, 1876, pp. 747-78.
22. Charles K. Palmer, *Improvement of Navigation on the Ohio River* (pamphlet; Cincinnati, 1938), pp. 52-53; ARCE, 1882, pp. 1877-79; John C. Oakes, "Works at the Falls of the Ohio River, Louisville, Ky." *Military Engineer*, VI (September-October, 1914), 572.
23. Godfrey Weitzel to Major George W. Davis, July 14, 1879, in Weitzel Letterbook, Manuscript Division, Cincinnati Historical Society.
24. ARCE, 1876, pp. 751-63; ARCE, 1877, pp. 640-41.
25. ARCE, 1875, pp. 772-76; ARCE, 1878, p. 788.
26. ARCE, 1876, pp. 751-52; ARCE, 1875, p. 782; ARCE, 1880, p. 1725.
27. ARCE, 1880, p. 1725; John C. Oakes, "Works at the Falls of the Ohio River, Louisville, Ky.," *Military Engineer*, VI (September-October, 1914), 570; Harry Burgess to C. W. Holbrook, September 18, 1905, in Kansas City Federal Records Center, Box NA1045, Folder L&P.C. 77/3, NA. RG 77. In 1905 the works at the Louisville and Portland canal consisted of 125 acres of land, the canal and locks, a dry dock; automatic gate, movable dam at head of canal, three draw-bridges across the canal and locks; 6 lock-engine houses; residence and office for assistant engineer; stone machine shop; boiler house; stone and brick blacksmith shop; power house; store house; frame carpenter shop; planing and saw mill; frame coal bin; branch office at head of canal; and floating plant, which included one towboat (probably the *Walker Morris*), three dredges, six mud scows, and four barges. The dry docks could handle vessels as large as 225 feet by 54 feet, and was used for construction and repair of government floating plant and rented to private boatowners when not in use. The equipment and structures at the canal not connected immediately with lock operation eventually were designated the Louisville Repair Station and were still in operation in 1975.
28. ARCE, 1883, pp. 1527-28, 1533; William E. Merrill to Editor, *Louisville Times*, August 17, 1885, in "Appointments to Various Positions on Louisville and Portland Canal, May 15, 1884-December 14, 1893," Office of Administrative Services, Louisville Engineer District, Louisville, Kentucky. This manuscript volume of correspon-

dence was preserved by various employees of the District over the years, and in 1972 was bound and filed in a vault in ORLAS. It is cited hereinafter as "LPC Letterbook."

29. Affidavit of Philip Gebertshan, July 31, 1886, in "LPC Letterbook."

30. O. H. Stratton to William E. Merrill, June 3, 1885, *ibid.*

31. John M. Wilson to William E. Merrill, June 9, 1885, *ibid.*; W. E. Merrill to John Newton, July 23, 1885, *ibid.*

32. *Louisville Democrat*, November 19, 1885; *Louisville Courier-Journal*, October 8, 1885.

33. William E. Merrill to John Newton, December 23, 1885, in "LPC Letterbook"; William E. Merrill to Pink Varble, January 8, 1886, *ibid.*; William E. Merrill to John Newton, October 20, 1885, *ibid.*

34. Simon B. Buckner to William E. Merrill, January 11, 1886, *ibid.*; W. E. Merrill to Editor, *Commercial Gazette*, February 3, 1886, *ibid.*; John M. Wilson to William E. Merrill, February 4, 1886, *ibid.*; William E. Merrill to John Newton, February 6, 1886, *ibid.* Biographical information related to Thomas H. Taylor may be located in Ezra J. Warner, *Generals in Gray: Lives of the Confederate Commanders* (Baton Rouge, 1959), pp. 300-01, and "Memo Relating to General Thomas H. Taylor," Secretary of War to Engineer Department, n. d., "Letters Received, Engineer Department, 1886 (No. 1286)," NA, RG 77.

35. William E. Merrill to John MacLeod, February 13, 1886, in "LPC Letterbook"; Amos Stickney to J. P. Claybrook, March 24, 1887, *ibid.*; ARCE, 1886, p. 1569. Major Stickney moved into an office at 507 W. Chestnut. In 1893 the office was relocated to the fourth floor of the U. S. Customhouse at 4th and Chestnut; in 1932 it moved to a new Federal Building at 6th and Broadway; in 1946 it moved to the Gibbs-Inman Building at 830 West Broadway — the building was purchased by the United States; and in 1975 the District office was located in an imposing new Federal Building in downtown Louisville.

36. Albert S. Willis to W. C. Endicott, June 8, 1886, in

Engineer Department, "Letters Received, 1886. (No. 2677 B/417)," NA, RG 77; Albert Willis to Secretary of War, October 15, 1886, in "LPC Letterbook."

37. Amos Stickney to Thomas L. Casey, April 10, 1889, in "LPC Letterbook"; Thomas L. Casey to Amos Stickney, May 6, 1889, *ibid.*; ARCE, 1889, p. 1913.

38. C. O. Bradford to President of United States, October 18, 1889, "LPC Letterbook"; anonymous to G. J. Lydecker, June 25, 1891, *ibid.*; Thomas Costello to President Benjamin Harrison, June 10 and June 18, 1891, *ibid.*

39. R. R. Jones to Edward Maguire, May 30, 1890, *ibid.*; G. J. Lydecker to Chief of Engineers, June 29, 1891, *ibid.*; L. A. Grant to Chief of Engineers, August 30, 1892, *ibid.*

40. G. J. Lydecker to Thomas L. Casey, October 1, 1892, *ibid.*; H. M. Adams to G. J. Lydecker, March 24, 1893, *ibid.*; "Memorandum made at the request of those who signed the petitions from Pittsburgh and Cincinnati river interests to the President," received by OCE on March 27, 1893, *ibid.*; ARCE, 1894, p. 1940.

41. ARCE, 1894, p. 1940; "Hiram Martin Chittenden, M. ASCE," *Transactions of American Society of Civil Engineers*, LXXXII (1918), 1675-78. An illustrated account of Chittenden's work at Yellowstone National Park is Francis X. Kelly, "Early Preservation of 'Pleasuring Grounds,'" *Water Spectrum*, IV (Fall, 1972), 37-41.

42. Secretary of War to Chief of Engineers, June 25, 1897, in "General Correspondence, 1894-1923," NA, RG 77.

43. Chief of Engineers, "Memorandum for the Secretary of War," attached to William H. Taft to J. M. Dickinson, January 19, 1911, in "General Correspondence, 1894-1923," NA, RG 77, summarized the history of the political troubles at Louisville canal.

44. *Ibid.*

45. *Ibid.*

46. Lytle Brown, "Federal River and Harbor Policies," *Civil Engineering*, V (August, 1935), 462.

CHAPTER IX: FOOTNOTES

1. Verhoeff, *Kentucky River Navigation*, p. 18n; "River Navigation in Indiana," *Indiana Magazine of History*, II (March, 1906), 89-93; Logan Esarey, "Internal Improvements in Early Indiana," *Indiana Historical Society Publications*, V (1912), 60-61.

2. Godfrey Weitzel to H. M. Rice, November 30, 1878, Wetzel Letterbook, Manuscript Division, Cincinnati Historical Society.

3. Officers of the Corps of Engineers surveyed the portages between the Wabash and the Great Lakes on several occasions during the nineteenth century; and the Cross-Wabash Waterway was still under study in 1975.

4. Niles' *Weekly Register*, XL (May 21, 1831), 194; *Western Sun*, June 17, 1826; Fort Wayne Public Library, *Boatmen on the Wabash, 1830* (pamphlet; Fort Wayne, 1954), *passim*; Donald F. Carmony, "Flatboat Building on Little Raccoon Creek, Parke County, Indiana," *Indiana Magazine of History*, LX (December, 1964), 305-22; Eleanore A. Cammack, "Notes on Wabash River Steamboating: Early Lafayette," *Indiana Magazine of History*, L (March, 1954), 35-50; William E. Wilson, *The Wabash* (New York, 1940), pp. 177, 266-67.

5. Esarey, "Internal Improvements in Early Indiana," pp. 63-65; copy of the Polke-Hinde report is inclosed in John L. Smith to Charles Gratiot, February 7, 1831, "Letters Received by Topographical Bureau, 1824-1865," (S. 1219) NA, RG 77.

6. U. S., Congress, House, *Wabash River*, H. Doc. No. 208, 22 Cong., 1 Sess., 1832, *passim*.

7. U. S., Congress, Senate, Committee on Roads and Canals, *Report on "A Bill to Improve the Navigation of the Wabash River,"* S. Ex. Doc. No. 164, 23 Cong., 1 Sess., 1834, *passim*; Esarey, "Internal Improvements in Early Indiana," pp. 76-77; U. S., Congress, House, *Message from the President of the United States to the Two Houses of Congress*, H. Ex. Doc. No. 2, 23 Cong., 2 Sess., 1834, pp. 21-22.

8. ARCE, 1873, pp. 512-17; Hunter, *Steamboats on Western Rivers*, p. 186; U. S., Congress, House, *Site For a Western Armory*, H. Ex. Doc. No. 133, 27 Cong., 3 Sess., 1843, pp. 239-41.

9. ARCE, pp. 485-90.

10. ARCE, 1873, pp. 510-17; ARCE, 1877, pp. 667-73; ARCE, 1879, pp. 1439-60.

11. ARCE, 1877, pp. 667-73; ARCE, 1879, pp. 1439-60.

12. ARCE, 1879, pp. 1439-60; ARCE, 1883, p. 1589.

13. ARCE, 1886, pp. 1582-83; ARCE, 1895, pp. 2443-44; ARCE, 1894, p. 1945.

14. ARCE, 1898, pp. 1980-81; ARCE, 1904, pp. 2729-41.

15. W. P. Greene, ed., *The Green River Country from Bowling Green to Evansville, Its Traffic, Its Resources, Its Towns, and Its People* (Evansville, 1898), pp. 11, 127-28; Gilliam J. Johnson (old Green River raftsmen), private interview, August 6, 1971.

16. *Louisville Public Advertiser*, January 15, 1831, prints

an account of the voyage of the *McLean* by its pilot, J. O. Curry. See, however, statement that the first steamboat to reach Bowling Green was the *United States* and supporting evidence in Helen B. Crocker, "Green River Steamboating: A Cultural History, 1828-1931" (unpublished master's thesis, Western Kentucky University, 1970), p. 20. Consult the history of the slackwater projects of Kentucky in Joe F. Decker, "The Board of Internal Improvement of Kentucky, 1835-1850" (unpublished master's thesis, University of Louisville, 1964). Correspondence relating to Army Engineer survey of the Green and Barren rivers may be located in "Registers of Letters Received, Topographical Bureau, 1824-1866," NA, RG 77. An account of construction of the Green-Barren project written by the state engineer is printed in U. S., Congress, House, *Survey of the Ohio River*, H. Ex. Doc. No. 72, 41 Cong., 3 Sess., 1871, pp. 48-49, 53-54.

17. U. S., Congress, House, *Survey of the Ohio River*, H. Ex. Doc. No. 72, 41 Cong., 3 Sess., 1871, pp. 48-49, 53-54; Kentucky Board of Internal Improvement, *Report from the Board of Internal Improvement* (pamphlet; Frankfort, 1843), pp. 10-16.

18. See note 17 above.

19. *Louisville Journal*, December 7, 1841; Kentucky Board of Internal Improvement, *Report from the Board of Internal Improvement* (Frankfort, 1843), pp. 5-6; Crocker, "Green River Steamboating: A Cultural History, 1828-1931," pp. 21-34.

20. W. P. Greene, ed., *The Green River Country* . . . , pp. 15-17; ARCE, 1880, pp. 1823-24.

21. W. S. Overstreet to E. H. Ruffner, September 8, 1902, "General Correspondence, 1894-1923," NA, RG 77; Don C. Buell, *Memorial of D. C. Buell and Others Concerning the Green and Barren River Navigation Company and Its Relation to the Green River Country* (Airdrie, Ky., 1880), *passim*; U. S., Congress, House, *Green and Barren River Navigation Company*, H. Ex. Doc. No. 111, 49 Cong., 2 Sess., 1887, p. 14.

22. ARCE, 1880, 1799-1824; ARCE, 1885, pp. 1904-16.

23. Crocker, "Green River Steamboating: A Cultural History, 1828-1931," pp. 84-114, provides an extensive discussion of the company and steamboat commerce of the era. ARCE, 1889, pp. 84-114. Calhoun *Constitution*, February 20, 1890; Edward B. Clark, William L. Sibert, *The Army Engineer* (Philadelphia, 1930), p. 26.

24. ARCE, 1890, pp. 2259-60; ARCE, 1891, p. 2439; Calhoun, Kentucky, *Constitution*, February 20, March 26, July 29, August 26, September 30, 1890; Calhoun, Kentucky *Courier*, December 11, 1890 (the rather rare copies of the Calhoun newspapers are located at Kentucky Library, Western Kentucky University, Bowling Green); Crocker, "Green River Steamboating: A Cultural History, 1828-1931," p. 117.

25. Calhoun *Constitution*, March 19, 1890; ARCE, 1885, pp. 1894-99.

26. ARCE, 1891, pp. 2446-48; ARCE, 1895, pp. 2481-82; W. P. Greene, ed., *The Green River Country* . . . , p. 58; ARCE, 1889, pp. 2599-2604; Samuel B. Settle, "William McLaurine Hall, M. ASCE," *Transactions of American Society of Civil Engineers*, CXVII (1952), 1301-02.

27. ARCE, 1889, pp. 2599-2604; ARCE, 1898, p. 2011; Louisville District, "Preliminary Draft of Comprehensive Plan" (manuscript report to OCE, October 3, 1913), in Kansas City Federal Records Center, Box NA1044, Folder 1943/19/Misc, NA, RG 77.

28. ARCE, 1880, pp. 1802-22.

29. ARCE, 1891, pp. 2474-82; W. P. Greene, ed., *The Green River Country* . . . , pp. 56-58; Crocker, "Green River Steamboating: A Cultural History, 1828-1931," pp. 117-22.

30. Cincinnati District, *Histories of Navigation on the Ohio and Kentucky Rivers and Engineering Projects in the Cincinnati U. S. Engineer District* (rare pamphlet in NA1141, Misc, 20, NA, RG 77; Cincinnati, 1937), p. 28; Verhoeff, *Kentucky River Navigation*, pp. 95-96; John W. Cole-

man, *Steamboats on the Kentucky River* (pamphlet; Lexington, 1960), pp. 6-7; Thomas D. Clark, *The Kentucky* (New York, 1943), pp. 72-87; *Louisville Public Advertiser*, October 27, 1818.

31. Verhoeff, *Kentucky River Navigation*, pp. 24-27; Cincinnati District, *Histories of Navigation on the Ohio and Kentucky* . . . , pp. 19-23; U. S., Congress, House, *Survey - Kentucky River*, H. Doc. No. 58, 20 Cong., 2 Sess., 1829, *passim*. The maps prepared during the 1828 survey were on file in Louisville Engineer District for many years; about 1965 they were deposited in the National Archives, but a microfilm copy is located in Surveys Branch, Louisville Engineer District, under the title "Kentucky River Maps and Survey, 1829-1946."

32. ARCE, 1879, pp. 1400-01; Verhoeff, *Kentucky River Navigation*, pp. 104-06 (see Appendix also).

33. *Frankfort Commonwealth*, September 27, 1834; ARCE, 1879, p. 1408.

34. Verhoeff, *Kentucky River Navigation*, pp. 29-32; Coleman, *Steamboats on the Kentucky River*, pp. 13-14, 25-26; ARCE, 1898, p. 2012. *Haldeman's Picture of Louisville, Directory and Business Advertiser, for 1844-1845*, p. 77, commented: "Since the State's improvements on this noble river have been completed, a vast amount of produce, from the rich and productive counties of the interior, is brought to Louisville, by this channel, which formerly came over land, at greatly enhanced freights." The *New Argo*, Captain Armstrong, was the first steamboat to pass through the locks, arriving at Frankfort, Kentucky, on February 14, 1840. See M. R. Stealey, Resident Engineer, to Sylvester Welch, Chief Engineer of Kentucky, December 1, 1840, in *Journal of the Franklin Institute*, XXXI (May, 1841), 377-79.

35. Verhoeff, *Kentucky River Navigation*, pp. 32-33; Cincinnati District, *Histories of Navigation on the Ohio and Kentucky* . . . , pp. 23-24, 28; and notes in *Engineering News*, V (March 7 and April 25, 1878), 74, 129.

36. ARCE, 1879, pp. 1410-10; ARCE, 1880, pp. 1825-27.

37. ARCE, 1882, pp. 1945-51; ARCE, 1885, pp. 1869-83; Coleman, *Steamboats on the Kentucky River*, pp. 31-34.

38. ARCE, 1883, pp. 1559-64; Verhoeff, *Kentucky River Navigation*, pp. 37-38; Clark, *The Kentucky*, pp. 321-38.

39. ARCE, 1884, pp. 1728-31; maps and diagrams of the site and structure are printed in *ibid.*, pp. 1731-46.

40. *Ibid.*; Cincinnati District, *Histories of Navigation on the Ohio and Kentucky* . . . , pp. 26-27; ARCE, 1890, p. 2263; ARCE, 1891, p. 2449.

41. J. Stoddard Johnston, "The Kentucky River in Its Relation to the Development of the Eastern Kentucky Coal Field," in *Kentucky Resources: Transportation Systems* (Frankfort, 1887), p. 57.

42. ARCE, 1898, pp. 2012-17; Verhoeff, *Kentucky River Navigation*, pp. 33-36. The Corps of Engineers reconstructed, repaired, and modified these structures many times after their completion. In March, 1905, for example, floods breached banks adjacent to Locks and Dams Nos. 9 and 10, and loss of pool resulted. Auxiliary dams were constructed to close the breaches and navigation was restored in 1906.

43. Holt, *OCE*, pp. 20-21; ARCE, 1872, p. 420-25.

44. Ila Earle Fowler, "The Tradewater River Country in Western Kentucky," *Register of Kentucky Historical Society*, XXXII (October, 1934), 277-300; *Congressional Record*, 45 Cong., 2 Sess., VII, Pt. 3, 2747. The friend of Cox who made the remark was probably Congressman John C. Carlisle, a former Lieutenant Governor of Kentucky.

45. *Ibid.*, p. 2749.

46. ARCE, 1881, pp. 1991-94; ARCE, 1882, pp. 1959-63; ARCE, 1886, pp. 1617-18; ARCE, 1891, p. 2438.

47. ARCE, 1897, pp. 2477-81; U. S. Congress, House, *Tradewater River, Kentucky*, H. Doc. No. 179, 58 Cong., 2 Sess., 1903, *passim*.

48. Pross, "A History of Rivers and Harbors Appropriation Bills, 1866-1933," p. 71.

49. *Ibid.*, p. 238; ARCE, 1893, p. 2546. See also "Government Engineering," *Engineering News*, VI (December 6, 1879), 393; and Emory R. Johnson, *Inland Waterways, Their Relation to Transportation* (Annals of American Academy of

Political and Social Science supplement, September, 1893; Philadelphia, 1893), p. 119.

50. President Taft is quoted in "No More 'Pork Barrels,'" *Literary Digest*, XLI (July 9, 1910), 39-42.

CHAPTER X: FOOTNOTES

1. U. S., Congress, House, *Survey of the Ohio River*, H. Ex. Doc. No. 72, 41 Cong., 3 Sess., 1871, *passim*.

2. ARCE, 1869, p. 52; *Pittsburgh Commercial*, May 22, 1875; Louisville *Courier-Journal*, August 1-2, 27, 1869; Frederick Way, "The Early Lighthouse Service," *S&D Reflector*, VII (June, 1970), pp. 37-40; Hunter, *Steamboats on Western Rivers*, pp. 247-48.

3. ARCE, 1867, pp. 40-41, 402-04; ARCE, 1868, pp. 680-88; ARCE, 1869, pp. 352-68.

4. W. Milnor Roberts to Chief of Engineers, March 15, 1870, in Engineer Department, "Registers of Letters Received, 1866-1870," NA, RG 77; John Bogart, "William Milnor Roberts, Past President, ASCE," *Transactions of American Society of Civil Engineers*, XXXVI (December, 1896), 531-37.

5. ARCE, 1870, pp. 406-16; ARCE, 1871, pp. 385-92; Margaret E. Merrill, "William E. Merrill," *Professional Memoirs*, IX (November-December, 1917), 639-42.

6. ARCE, 1873, p. 495; ARCE, 1872, pp. 398-406.

7. Hunter, *Steamboats on Western Rivers*, pp. 115-16; Theodore Allen, "Iron Hulls for Western River Steamboats," *Transactions of American Society of Civil Engineers*, II (1873), 271-87; ARCE, 1874, pp. 404-05; ARCE, 1876, II, 7; ARCE, 1877, p. 628; ARCE, 1924, p. 1259; Frederick Way, Jr., to Leland R. Johnson, May 12, 1972, author's personal files.

8. ARCE, 1873, pp. 495-96; ARCE, 1874, pp. 400-04; editorial note, *S&D Reflector*, VII (March, 1970), 24-25.

9. ARCE, 1879, p. 1308; William W. Harts, "Improvement of Rivers," *Professional Memoirs*, V (March-April, 1913), 139-61. In *Pittsburgh Commercial*, May 22, 1875, Colonel Merrill wrote:

The work thus far done on the Ohio has been limited to closing island chutes, where neither channel had a sufficiency of water, and to narrowing the channel by dikes or wing dams wherever the water was spread over a wide shoal. These works have been moderately successful, but it is well known to all engineers that in such a river as the Ohio, whose summer supply dwindles down to almost nothing, no radical improvement is possible by more concentration.

10. See complete report in U. S., Congress, House, *Survey of the Ohio River*, H. Ex. Doc. No. 72, 41 Cong., 3 Sess., 1871 (quotation on p. 6).

11. Richard Collins and Lewis Collins, *History of Kentucky*, I, 222-23; Ohio River Commission, *Memorial to Congress of the Commission for the Improvement of the Ohio River and Its Tributaries* (pamphlet; Cincinnati, 1872), *passim*; ARCE, 1873, p. 502; U. S., Congress, Senate, *Report of the Select Committee on Transportation-Routes to the Seaboard*, S. Rept. No. 307, 43 Cong., 1 Sess., 1874, pp. 218-20.

12. ARCE, 1872, pp. 398-406; ARCE, 1873, pp. 499-502, 540-42; ARCE, 1874, pp. 415-81, prints the report of Merrill and Weitzel on "Radical Improvement of the Ohio River by Hydraulic Gates and Movable Dams."

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Records Center, Box NA1141, Folder Ohio 450, NA, RG 77), *passim*; James A. Henderson, "Reminiscences of the Rivers," *Western Pennsylvania Historical Magazine*, XII (October, 1929), 235-36.

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15. see the descriptions by various Engineers in William E. Merrill, "Movable Dams," *Engineering News*, V (March 28, 1878), 100-01; Walter W. Gruber, "Construction of the Chanoine Weir," *Military Engineer*, XVII (March-April, 1925), 149; Francis H. Oxx, "The Ohio River Movable Dams," *Military Engineer*, XXVII (January-February, 1935), 49-58.

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18. Ambler, *Transportation in Ohio Valley*, p. 407; ARCE, 1876, II, 14; "Memorial Relative to the Ohio River Navigation, from the Pittsburgh Coal Exchange and the Steamboatmen's Association," January 17, 1876, in ARCE, 1877, pp. 645-54.

19. U. S., Congress, *Report of the Select Committee on Transportation-Routes to the Seaboard*, S. Rept. No. 307, 43 Cong., 1 Sess., 1874 *passim* (see especially pp. 215-18); *Pittsburgh Commercial*, May 18, 1875.

20. ARCE, 1875, p. 686; ARCE, 1876, II, 11-14; editorial note in *Engineering News*, IV (December 8, 1877), 345.

21. ARCE, 1879, pp. 1299-1300; William E. Merrill to Morrison Foster, September 17, 1885, in Davis Island Dam, Letter Book No. 4, Philadelphia Federal Records Center, NA, RG 77; William E. Merrill to George Dewey, October 16, 1882, in Davis Island Dam, Letter Book No. 2, *ibid.* Complete description of the project, including diagrams and photographs, was prepared by the project engineer and printed in William Martin, "Davis Island Dam, Ohio River," *Engineering News*, XV (May 15, 1886), 306-11.

22. Martin, "Davis Island Dam, Ohio River," *passim*; William L. Sibert, "The Improvement of the Ohio River," *Transactions of American Society of Civil Engineers*, LXIII (1909), 405-10.

23. See note 22 above.

24. ARCE, 1886, p. 1528; Frederick Way, "Davis Island Dam Celebration," *S&D Reflector*, III (June, 1966), pp. 1, 6; Louisville *Courier-Journal*, October 8, 1885; *Pittsburgh Evening Penny Press*, October 7, 1885; Pittsburgh Chamber of Commerce, *Reports to the Chamber upon the Opening of Davis Island Dam, Together with Interest-Data* (pamphlet; Pittsburgh, 1886), *passim* (Merrill is quoted on p. 29).

25. See note 24 above and *Pittsburgh Evening Penny Press*, October 9, 1885. The name of the boat was not given in the newspaper account.

26. ARCE, 1885, p. 1799-1800; ARCE, 1889, p. 1878; editorial note, *Engineering News*, XXII (July 27, 1889), 73; ARCE, 1891, pp. 2350-51; J. W. Arras, "Locks and Movable Dams of the Ohio River," *Professional Memoirs*, III

(October-December, 1911), 546-50.

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30. William L. Sibert, "The Improvement of the Ohio River," p. 400; editorial note, *Engineering News*, LII (November 17, 1904), 443; ARCE, 1893, p. 2485; Ambler, *Transportation in Ohio Valley*, pp. 409-10; John L. Vance, "Sketch of Ohio River Improvements," *Ohio Archaeological and Historical Quarterly*, XVIII (1909), 417; Frederick Way, "Virginia's First Season," *S&D Reflector*, II (June, 1965), 1-6.

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356-68; Charles McD. Townsend, "Decline of Water Transportation on Western Rivers," *Professional Memoirs*, II (January-March, 1910), 20-29; U. S., Congress, House, *Ohio River*, H. Doc. 492, 60 Cong., 1 Sess., 1908, pp. 16-21.

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37. Kentucky Legislature to Chief of Engineers (copy of Memorial to Congress), April 25, 1906, in Engineer Department, "General Correspondence, 1894-1923," NA, RG 77.

38. Pross, "History of Rivers and Harbors Appropriation Bills, 1866-1933," pp. 108-09; Ambler, *Transportation in Ohio Valley*, pp. 353-54; "Public Expenditures for Inland Waterways Improvements," *Engineering News*, LXI (May 6, 1909), 498.

39. *Rivers and Harbors Laws*, III, 57-58; Pross, "The History of Rivers and Harbors Appropriation Bills, 1866-1933," pp. 108-09; Ambler, *Transportation in Ohio Valley*, pp. 353-54.

40. U. S., Congress, House, *Ohio River*, H. Doc. No. 492, 60 Cong., 1 Sess., 1908, pp. 1-3.

41. *Ibid.*, pp. 115-16.

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CHAPTER XI: FOOTNOTES

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4. ARCE, 1896, p. 2225; ARCE, 1898, pp. 1952-56.

5. ARCE, 1907, pp. 1796-98; John C. Oakes, "Works at the Falls of the Ohio River, Louisville, Ky.," *Military Engineer*, VI (September-October, 1914), pp. 572-75.

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12. George M. Hoffman to Chief of Engineers, July 23, 1920, OCE, "General Correspondence, 1894-1923," NA, RG 77.

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14. G. R. Lukesh to C. W. Kutz, March 17, 1923, OCE, "General Correspondence, 1894-1923," NA, RG 77.

15. Edward B. Clark, William L. Sibert, *the Army Engineer, passim*.

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17. U. S., War Department, Board of Engineers for Rivers and Harbors, *Transportation on the Ohio River System (Interim Report)* (Washington, 1927), pp. 8-9; William M. Hall, "Some Notes on the Location and Construction of Locks and Movable Dams on the Ohio River . . .," *Transactions of American Society of Civil Engineers*, LXXXVI (1923), 135-36, quotes Colonel Roberts.

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22. Hall, "Some Notes on the Location and Construction of Locks and Movable Dams on the Ohio River . . .," pp. 156-57, 174-75.

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33. See note 32 above, and John C. Oakes to Chief of Engineers, June 10, 1916, in OCE, "General Correspondence, 1894-1923," NA, RG 77.

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42. *ARCE*, 1930, p. 1317; notes in *S&D Reflector*, VIII (December, 1971), 54-59; Ambler, *Transportation in Ohio Valley*, pp. 417-18.

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and Harbors, *Transportation on the Ohio River System*, pp. 11-12; ARCE, 1926, p. 1157; Ambler, *Transportation in Ohio Valley*, pp. 444-46.

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CHAPTER XII: FOOTNOTES

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3. ARCE, 1871, p. 398; *Cincinnati American*, February 16, 1832.

4. S. P. Hildreth, "A Brief History of the Floods in the Ohio River . . .," pp. 7-14; *Louisville Public Advertiser*, February 23, 1832, see also *ibid.*, February 25, 1832, for further flood reports.

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6. ARCE, 1873, pp. 500-01; U. S., Congress, Senate, *Report of the Select Committee on Transportation-Routes to the Seaboard*, S. Rept. No. 307, 43 Cong., 1 Sess., 1874, p. 530.

7. ARCE, 1883, pp. 1515, 1533, 1537.

8. ARCE, 1884, p. 1687; Cincinnati Relief Committee, *The Flood in the Ohio, February, 1884* (Cincinnati, 1884), p. 19.

9. "Regulation of Western Rivers," *Engineering News*, XI (February 23, 1884), 92.

10. ARCE, 1884, pp. 1689-92; ARCE, 1885, pp. 1796-98.

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12. ARCE, 1885, pp. 1828, 1839-42.

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20. Morgan, *The Miami Conservancy District*, p. 167.

21. *Ibid.*, pp. 227, 292-93; Hiram M. Chittenden, "Detention Reservoirs with Spillway Outlets as an Agency in Flood Control," *Transactions of American Society of Civil Engineers*, LXXXII (1918), 1493.

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23. Miami Conservancy District, State of Ohio, *Report of the Chief Engineer, Arthur E. Morgan, Submitting A Plan for the Protection of the District from Flood Damage* (3 vols.; Dayton, Ohio, 1916), *passim*; Charles H. Paul, "The Flood Control Works of the Miami Conservancy District," *Military Engineer*, XIV (May-June, 1922), 141-46.

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25. John W. Lane, "Flood Control — Ohio Leads the Way," *Ohio Contractor*, September, 1968, n. p.

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perform this type of report.

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28. U. S., Congress, House, *Prevention of Damage by Floods*, H. Doc. No. 914, 63 Cong., 2 Sess., 1914, *passim*; U. S., Congress, House, *Flood Protection and Prevention*, H. Doc. No. 1792, 64 Cong., 2 Sess., 1916, *passim*. Major Oakes of Louisville District stated it as his opinion that the "inhabitants of the Ohio River Valley are demanding, and are going to obtain an investigation" of flood control, and recommended thorough and comprehensive studies by the Corps. On the other hand, there were Corps officers who opposed comprehensive flood control planning. Colonel Charles McD. Townsend wrote: "The systematic conservation and regulation by the Government of a river from its source to its mouth sounds most attractive, suggesting a scientific solution of every problem of river hydraulics, but instead I greatly fear that it is the voice of a siren luring the people to an open pork barrel for every stream in the United States." See John C. Oakes to Senior Member, Board of Officers on River Floods, November 22, 1915, in Engineer Department, "General Correspondence, 1894-1923," NA, RG 77; And Charled McD. Townsend, "Control of River Floods," *Professional Memoirs*, V (July-August, 1913), 429.

29. *Rivers and Harbors Laws*, III, 1706-07, 1885; ARCE, 1927, p. 5; ARCE, 1951, Pt. I, Vol. III, 228-29.

30. *Congressional Record*, April 9, 1930, p. 7092.

31. T. P. Pendleton, "Photographing the Wabash," *Military Engineer*, XXIII (July-August, 1931), 345-51; Maybin H. Wilson, "Contract Mapping in the Louisville District," *ibid.*, pp. 340-44 (quote on 344).

32. U. S., Congress, House, *Wabash River, Ohio, Indiana, and Illinois*, H. Doc. No. 100, 73 Cong., 1 Sess., 1934, pp. 91-95; Gilbert Van B. Wilkes to Dabney O. Elliott, May 18, 1935, in Kansas City Federal Records Center, Box NA1119, Folder 1713.1/188, NA, RG 77.

33. U. S., Congress, House, Committee on Flood Control, *Comprehensive Flood Control Plan: Hearings on H. R. 7393*, 75 Cong., 1 Sess., 1937, pp. 401-02.

34. U. S., Congress, House, *Green, Baren, and Rough Rivers, Ky.*, H. Doc. No. 81, 73 Cong., 1 Sess., 1933, pp. 1-5.

35. *Ibid.*

36. U. S., Congress, House, *Ohio River*, H. Doc. No. 306, 74 Cong., 1 Sess., 1936, *passim* (see especially pp. 1-7); Douglas L. Weart and J. W. Bruce, "Ohio River Basin Flood Control Plan," *Military Engineer*, XL (August, 1948), 345-47.

37. See note 36.

38. See note 36.

39. "Record Floods from New England to the Potomac," *Engineering News-Record*, CXVI (March 26, 1936), 441-42.

40. "Restore and Protect!" *Engineering News-Record*, CXVI (March 26, 1936), 471; editorial note, *ibid.*, CXVI (May 28, 1936), 793; ARCE, 1936, pp. 3, 6.

41. ARCE, 1936, pp. 1144-45.

42. Paschal N. Strong, "The Great Flood of the Ohio," *Military Engineer*, XXIX (May-June, 1937), 157; Louisville District Engineer to Chief of Engineers, December 2, 1937, incloses "Report on flood of January-February, 1937 — Louisville District," in Kansas City Federal Records Center, Box NA1115, Folder 1713.33/555, NA, RG 77.

43. See note 42, and Stanley J. Horn, "The Flood of 1937 in the Ohio Valley: Cause, Magnitude, and Possibility of Recurrence: General Plan for Future Protection Works," *Civil Engineering*, VII (May, 1937), 326-28.

44. George P. Stimson, "River on a Rampage: An Account

of the Ohio River Flood of 1937," *Cincinnati Historical Society Bulletin*, XXII (April, 1964), 91-109; U. S., Congress, House, Committee on Flood Control, *Comprehensive Flood-Control Plans: Hearings on Report of Chief of Engineers*, April 6, 1937, 75 Cong., 3 Sess., 1938, p. 423, quotes Victor M. O'Shaughnessy of Lawrenceburg.

45. Gustave A. Breaux, "1937 Flood at Louisville," *Filson Club History Quarterly*, XI (April, 1937), 109-18; Strong, "The Great Flood of the Ohio," p. 160. See also newspaper files for the period.

46. Louisville District, "Report of Damage Survey, Flood of January-February, 1937, Louisville District," dated July, 1937, in Kansas City Federal Records Center, Box NA1114, Folder 1713.33/7, NA, RG 77; Lockmaster Thomas J. Reid, Lock and Dam No. 44, log for the flood period is printed in *S&D Reflector*, VI (March, 1969), 2.

47. U. S., Congress, House, Committee on Flood Control, *Comprehensive Flood Control Plan for Ohio: Hearings on H. R. 7393 and H. R. 7646*, 75 Cong., 1 Sess., 1937, pp. 33-34, 109.

48. *Ibid.*, p. 6; Louisville District, "Report of Damage Survey, Flood of January-February, 1937, Louisville District," *passim*.

49. John Eschrick, "He Knows the Fury of War and Floods," *Louisville Courier-Journal*, April 7, 1946, describes the experiences of B. B. Talley and his conversation with OCE. B. B. Talley, who served as Louisville District Engineer, 1946-48, was the author of *Engineering Applications of Aerial and Terrestrial Photogrammetry* (New York: Pitman Publishing Corp., 1938).

50. Strong, "The Great Flood of the Ohio," pp. 157-58.

51. Oren H. Bellis (retired, Louisville District), private interview, February 26, 1973.

52. *Ibid.*

53. John H. Kurrasch (retired, Louisville District), private interview, February 27, 1973.

54. Testimony of R. C. Powell, June 9, 1937, in U. S., Congress, House, Committee on Flood Control Plan for Ohio: *Hearings on H. R. 7393 and H. R. 7646*, 75 Cong., 1 Sess., 1937, pp. 92-97; "Superflood Devastates Lower Ohio and Now Threatens Mississippi Levee System," *Engineering News-Record*, CXVIII (February 4, 1937), 205. Logs of the vessels of the Engineer fleet during the flood emergency are also of interest and may be located in Kansas City Federal Records Center, NA, RG 77.

55. Telegram dated January 21, 1937, in Kansas City Federal Records Center, Box NA1114, Folder 1713, 33/30, NA, RG 77. The Louisville District had eleven field parties, comprised of 60 men, engaged in collection of hydraulic data during the flood.

56. Manuel Faust to Franklin Roosevelt, January 29, 1937, in OCE, "Civil Works, 1923-42, Rivers and Harbors Files," NA, RG 77; A. Stiker to the President, February 5, 1937, *ibid.*; Theodore B. Floto to the President, January 30, 1937, *ibid.* These communications, along with many others, are filed in Box 1243 of *ibid.*

57. Greater New York Federation, National Negro Congress to Franklin Roosevelt, February 8, 1937, in *ibid.*

58. U. S., Congress, House, Committee on Flood Control, *Comprehensive Flood Control Plan for Ohio: Hearings on H. R. 7393 and H. R. 7646*, 75 Cong., 1 Sess., 1937, pp. 1-12; U. S. Army, Corps of Engineers, Ohio River Division, *Ohio Valley Flood Control Plan* (pamphlet: Cincinnati, 1940), *passim*.

59. ARCE, 1937, p. 1067; Louisville District, "History of Louisville District, Corps of Engineers," n. p.; Louisville District, Public Affairs Office, File 206-09 O. R., provides information on Mr. S. M. Bailey.

CHAPTER XIII: FOOTNOTES

1. Isabel M. McMeekin, *Louisville, The Gateway City* (New York, 1946), pp. 253-54, discusses the history of Jeffersonville Quartermaster Depot.

2. See reviews of the work of the Cantonment and Construction Division and General Goethals' recommendations in notes printed in *Engineering News-Record*, LXXX (March 7, 1918), 482; *ibid.*, LXXXI (September 12, 1918), 512; *ibid.*, LXXXIV (June 24, 1920), 1271.

3. Quartermaster Department, Construction Division, "Completion Report: Camp Knox, Kentucky" (unpublished report dated September 1, 1919, in "Completion Reports, 1917-43," NA, RG 77), *passim*; W. H. Radcliffe, "Completion Report, Camp Knox, Kentucky" (unpublished report dated 1919 in LDHF), *passim*.

4. See note 3 above.

5. McMeekin, *Louisville, The Gateway City*, pp. 249-51, reviews the history of Fort Knox.

6. Morgan, *The Miami Conservancy District*, pp. 353-54; Maurer Maurer, "McCook Field, 1917-27," *Ohio Historical Quarterly*, LXVII (January, 1958), 21-34.

7. *Ibid.*; Constructing Quartermaster, Dayton, Ohio, "Completion Report: Wright Field, Dayton, Ohio" (unpublished report dated 1926; in "Completion Reports, 1917-43," NA, RG 77), *passim*.

8. E. C. Itschner, "The Army Engineers' Contributions to American Defense and Advancement," text of address at Washington, D. C., April 3, 1959, pp. 9-10; "What the American Army Engineers Did in the War," *Engineering News-Record*, LXXXII (May 15, 1919), 953-54; *ibid.*, LXXXIII (December 11, 1919), 1030; *ARCE*, 1918, pp. 5, 2954; *ARCE*, 1919, p. 3133. There was an attempt to sabotage a lock in the Nashville Engineer District in 1917.

9. Ambler, *Transportation in Ohio Valley*, pp. 423-26; Lansing H. Beach to Louisville District Engineer, May 25, 1917, in Kansas City Federal Records Center, Box NA1044, Folder Misc. 5020 1, NA, RG 77; Report of William H. McAlpine, April 8, 1918, in *ibid.*, Folder Misc. 5112 7.

10. *ARCE*, 1917, pp. 2905-06; Robert R. Jones, "The Ohio River," pp. 73-76; "Commerce and Navigation on the Ohio" (undated three page manuscript, Ohio River Division Historical Files, Cincinnati), *passim*.

11. *ARCE*, 1920, p. 24.

12. War Department, Office of Chief of Engineers, "Rationale of Inland Waterway Transportation" (unpublished manuscript, dated 1940 and probably written by William H. McAlpine, NA, RG 77), pp. III-2-3. The use made of the Ohio River and tributary waterways during the Second World War is reviewed herein in Chapter XIII.

13. *ARCE*, 1942, p. 4. The mission transfer was authorized by Public Law No. 326, 77th Congress, December 1, 1941.

14. *ARCE*, 1941, p. 5.

15. Henry Hutchings, Jr., to Administrator, C. A. A., Department of Commerce, October 9, 1942, in "Civil Works, 1923-1942, District Files," NA, RG 77; Louisville District, "Completion Report: Development of Staniford Field, Louisville, Ky." (unpublished report dated 1943, in "Completion Reports, 1917-43," NA, RG 77), *passim*. Oren H. Bellis was Senior Engineer at the Staniford Field project.

16. "Airfield Paved with Local Materials," *Engineering News-Record*, CXXX (March 18, 1943), 390-91, describes construction of a C.A.A. field in the Louisville District. For security reasons, the identity and location of the field was not mentioned in the article, but internal evidence indicates it was the field at Bowling Green, Kentucky.

17. Chief of Engineers to Ohio River Division Engineer, May 27, 1942, in "Airfield Files, 1943-45," NA, RG 77; Henry Hutchings, Jr., to Chief of Engineers, July 18, 1941, in *ibid.*; Louisville District, "Completion Report for Air

Corps Construction, Godman Field, Fort Knox, Kentucky" (unpublished report dated 1942 in "Completion Reports, 1917-43," NA, RG 77), *passim*; Quartermaster Department, Bowman Field Officers, "Completion Reports — Bowman Field," in *ibid.*, *passim*; McMeekin, *Louisville, The Gateway City*, pp. 251-52.

18. Eugene Stokes, retired engineer of Louisville District, private interview, August 15, 1972; *River Rises*, October, 1945, pp. 5-13 (*River Rises* was an inhouse publication of the Louisville District during the wartime period; a complete collection is owned by Chauncey Carr, Personnel Office, Louisville District).

19. *River Rises*, June, 1945, pp. 4-8; *ibid.*, October, 1945, pp. 5-13.

20. *Ibid.*, May, 1945, p. 2; *ibid.*, July, 1945, p. 6; E. E. Gesler to Charles W. Barber, October 24, 1942, in "Civil Works, 1923-1942, District Files," NA, RG 77.

21. Eugene Reybold, Chief of Engineers, to Division Engineer, Ohio River, October 27, 1942, in Ohio River Division Historical Files, Cincinnati, inclosed the plan for reorganization.

22. *Ibid.*, C. L. Hall to Chief of Engineers, November 13, 1942, in *ibid.*; Great Lakes Division Engineer to Ohio River Division Engineer, November 16, 1942, in *ibid.* The military projects of Nashville Engineer District were supervised by South Atlantic Division; in 1943 Louisville District took over projects in Western Kentucky formerly administered by Nashville District.

23. *River Rises*, June, 1945, pp. 4-8.

24. Bureau of the Budget, War Projects Unit, "Abstract of Field Reports, Seymour Advance Twin Engine School" (unpublished report dated 1942), in "Airfield Files, 1943-45," NA, RG 77; William N. Taylor to Inspector General, November 14, 1942, in *ibid.*; Captain J. P. Case was Area Engineer at Seymour, Bureau of the Budget, War Projects Unit, "Abstract of Field Report: Lawrenceville, Illinois, Twin Engine School" (unpublished report dated 1942 in *ibid.*), Captain Edward H. Baldwin, Jr., was Area Engineer at George Field.

25. "Awarding of Army Contracts for Defense Plants Begins," *Engineering News-Record*, CXXV (August 22, 1940), 247-48; John A. Hunt to Inspector General, April 23, 1942, in "Geographic Files, 1943-45," NA, RG 77; Austin Griffith to Chief of Engineers, December 24, 1942, in "Airfield Files, 1943-45," in *ibid.*; W. C. Wright to Inspector General, September 20, 1945, in "Geographic Files, 1943-45," NA, RG 77; Morganfield Architect-Engineers, "Interim Report for Motorized Triangular Division Cantonment at Morganfield, Kentucky" (unpublished report dated 1941), in *ibid.*; John A. Hunt to Inspector General, April 15, 1942, in *ibid.*; Major Rees Willard was Area Engineer at Atterbury; Major Sultan G. Cohen was Area Engineer at Breckinridge. Reports on many other installations in the District are available in the files listed above.

26. See note 25 above.

27. S. N. Karrick to Inspector General, April 4, 1942, in "Geographic Files, 1943-45," NA, RG 77; Area Engineer, Ohio River Ordnance Works, "Completion Report, Job No. M9 41-1: The Anhydrous Ammonia Plant of the Ohio River Ordnance Works, West Henderson, Henderson County, Kentucky" (unpublished report dated 1942), in "Completion Reports, 1917-43," NA, RG 77; Area Engineer was Major D. M. Shryer; Atmospheric Nitrogen Corporation was the contractor.

28. "Nation's Largest Powder Plant Built in 9 Months," *Engineering News-Record*, CXXVII (August 7, 1941), 188-89; John S. Bragdon to Deputy Chief of Engineers, July 6, 1945, in "Geographic Files, 1943-45," NA, RG 77; Joseph L. Misora to Inspector General, February 22, 1943,

in *ibid.*; Winston Bros. Company, "History of the Construction of the Hoosier Ordnance Plant, Charlestown, Indiana" (2 vol. mimeo. report, 1942), in "Completion Reports, 1917-43," NA, RG 77.

29. G. H. Drewry to Chief of Engineers, February 9, 1942, in "Geographic Files, 1943-45," NA, RG 77; W. E. Kapp to Leslie R. Groves, February 27, 1942, in *ibid.*; Louisville District, "Completion Report, Job No. M1: Construction of Detonator Plant, Vigo Ordnance Plant, Terre Haute, Indiana" (unpublished report, 1943), in "Completion Reports, 1917-43," NA, RG 77; Area Engineer, Fall Creek Ordnance Plant, Louisville District, "Completion Report, Job No. M-1: Fall Creek Ordnance Plant, Indianapolis, Indiana" (unpublished report, 1943), in *ibid.* Completion Reports were filed on every military project and usually include photographs, diagrams, and other detailed information. These files should be consulted for information about any single project.

30. Area Engineer, Jefferson Proving Ground, Madison, Indiana, "Completion Report: Jefferson Proving Ground, Madison, Indiana" (unpublished report, 1942), in *ibid.*

31. Louisville District, "Completion Report Job T-1, Billings General Hospital, Fort Benjamin Harrison, Indiana" (unpublished report, 1942) in *ibid.*; William N. Taylor to Inspector General, November 13, 1942, in "Geographic Files, 1943-45," NA, RG 77.

32. Area Engineer, Darnall General Hospital, Danville, Kentucky, "Completion Report: Darnall General Hospital" (unpublished report, 1942), in "Completion Reports, 1917-43," NA, RG 77; William N. Taylor to Inspector General, November 7, 1942, in "Geographic Files, 1943-45," NA, RG 77; McMeekin, Louisville, *The Gateway City*, p. 252.

33. Eugene Reybold, "Engineers in World War II," *Military Engineer*, XXXVII (January, 1946), 24-29 (quote on p. 27).

34. W. C. Wright to Inspector General, September 20, 1945, in "Geographic Files, 1943-45," NA, RG 77; *River Rises*, November, 1945, pp. 3-7. During the war Engineer Redistribution Centers Nos. 1-3 were located in Louisville at 516 W. Main, 227 E. Lee, and at 26th and Canal streets. The Military Property Section and Salvage Branch were located in the Kenyon Building at 112 S. Fifth Street.

35. William F. Tompkins to George H. Rehm, April 17,

36. Oren H. Bellis, private interview, February 26, 1973. Lenore Fine and Jesse A. Remington, *The Corps of Engineers: Construction in the United States* (Washington, 1972), is the definitive history of military construction in the United States, 1940-1946.

37. *River Rises*, October, 1945, pp. 5-13; Secretary of War to Comptroller General, July 24, 1944, in "Military Records, District Offices, Louisville (File 132.2)," NA, RG 77.

38. Whiteney I. Gregory, "The Louisville District under Col. B. B. Talley" (3 page manuscript dated July 27, 1948, in LDHF); "History of Louisville District Real Estate Division, 23 July 1947-31 December 1965" (manuscript in Ohio River Division Historical Files, Cincinnati).

39. See note 38 above, and "Korea" (2 page manuscript in Ohio River Division Historical Files, Cincinnati).

40. *Ibid.*; "Summary of Important Operations, Louisville District, Corps of Engineers, during Colonel C. Bidgood's Three-Year Tenure as District Engineer" (6 page manuscript in LDHF).

41. "Statement of Missions: U. S. Army Engineer District, Louisville" (manuscript dated October 14, 1957 in LDHF); Louisville District, "History of Louisville District, Corps of Engineers" (pamphlet dated April, 1968, in LDHF), n. p.; Eugene Stokes, retired engineer, Louisville District, private interview, August 15, 1972.

42. U. S. Army, Corps of Engineers, *The Corps of Engineers: The Contributions of Its Civil Works to National Preparedness* (Washington, 1964), pp. 41-43.

43. ARCE, 1961, I, 51; Department of the Army, Office of Chief of Engineers, General Orders No. 12, 28 April 1961 (copy in LDHF); W. P. Leber to William F. Cassidy, July 23, 1965, (copy in LDHF); Louisville District, "History of Louisville District, Corps of Engineers," n. p.

44. Department of the Army, Office of Chief of Engineers, General Orders No. 24, 19 June 1970 (copy in LDHF); W. Roper to Frederick J. Clarke, July 2, 1970 (copy in LDHF). 1941, in "Civil Works, 1923-1942, Miscellaneous File," NA, RG 77; Louisville District, "Department of the Army, Corps of Engineers, Louisville District" (3 page manuscript dated October 1, 1948, in LDHF); ARCE, 1965, I, xxix; B. L. Robinson, "Remarks before the Texas Associated General Contractors Convention," text of address, December 6, 1954, Nashville District Historical Files.

CHAPTER XIV: FOOTNOTES

1. Colonel C. L. Hall to editor, July 15, 1936, *Engineering News-Record*, CXVII (August 20, 1936), 281, provides the cost comparisons.

2. Charles F. Michiels, William F. Lail, and Robert E. Mytinger, "Current Trends in Ohio River Traffic and Equipment," *Journal of Waterways and Harbors Division ASCE*, LXXXVII (December, 1956), paper 1123.

3. U. S. Army, Corps of Engineers, Ohio River Division, *Navigation of the Ohio River* (Cincinnati, 1938), pp. 12-13.

4. *Ibid.*, pp. 15-16; C. L. Hall to Louisville District Engineer, May 4, 1934, incloses a draft of a paper on Ohio River navigation structures to be presented to the Brussels Congress on Navigation, in Kansas City Federal Records Center, Box NA 1074, Folder 23.1/1494, NA, RG 77.

5. Edmund L. Daley, "The Mastery of the Ohio River," *Military Engineer*, XIX (May-June, 1927), 192; McAlpine, Ohio River Improvement, pp. 26-29.

6. C. L. Hall to Louisville District Engineer, May 4, 1934, in Kansas City Federal Records Center, Box NA 1074, Folder 23.1/1494, NA, RG 77.

7. *Ibid.*

8. *Ibid.*; John W. Arras, "Locks and Movable Dams of the Ohio River," *Professional Memoirs*, III (October-December, 1911), 535-61.

9. C. W. Kutz, "Ohio River Canalization — Its History and Possibilities," *Engineering News-Record*, CIV (March 13, 1930), 437; C. L. Hall, "Pack Ice and Movable Dams," *Military Engineer*, XXVI (July-August, 1934), 245-47. Col. C. L. Hall, Cincinnati District Engineer, said: "Too much credit can not be given to the men who actually did the fighting. The writer is District Engineer at Cincinnati, and is proud to be in charge of such brave, loyal and competent public servants."

10. Daley, "Mastery of the Ohio," p. 192; Seymour Reitman, "Anchor on the Castle," *Water Spectrum*, IV (Fall, 1972), pp. 33-35.

11. ARCE, 1934, p. 921, ARCE, 1935, p. 1049; Louisville District, "History of Louisville District, Corps of Engineers," n. p.

12. Charles K. Palmer, "Improvement of Navigation on the Ohio River," pp. 31-36; ARCE, 1932, p. 1245.

13. Louisville District, "History of Louisville District,

Corps of Engineers," n. p.; Whitney I. Gregory, "The Louisville District under Col. B. B. Talley," n. p.

14. Alexander S. Chamberlain, *The Role of the Ohio River in the Development of Ohio Valley Industry* (pamphlet; Cincinnati, 1960), p. 7; P. W. Loveland and T. P. Bailey, "Navigation on the Ohio River," *Military Engineer*, XLI (May-June, 1949), 174; U. S. Army, Corps of Engineers, *Report of the Federal Civil Works Program as Administered by the Corps of Engineers*, U. S. Army, 1951 (Washington, 1952; ARCE, 1951, Pt. 1, Vol. III), p. 48.

15. Haywood R. Faison, "Some Economic Aspects of Waterways Projects," *Transactions of American Society of Civil Engineers*, CXX (1955), 1486; "Markland" (unpublished manuscript; no author, no date, Public Affairs Office Files, Louisville District). Harry M. Mack, Chairman, Board of Trustees, Ohio Valley Improvement Association, testified before a Senate Committee in 1960 that:

We are confident, and I think it is self-evident, that low-cost water transportation afforded by the Ohio River and the abundant water supply that we have, coupled with the protection that we now have against the ravages of floods have constituted the principal basis for this remarkable industrial expansion. This huge flow of capital has greatly increased employment opportunities for the people of the valley and has contributed tremendously to their rapidly rising standard of living."

See U. S., Congress, Senate, *Water Resources, Hearings Pursuant to S. Res. 48*, 86 Cong., 2 Sess., 1960.

16. James W. Bruce, Dwight W. Keller, and James A. Neill, "Modern Facilities for Ohio River Navigation," *Journal of the Waterways and Harbors Division, ASCE*, LXXXIII (May, 1957), paper No. 1239; Eugene P. Fortson and George B. Fenwick, "Navigation Model Studies of New Ohio River Locks," *ibid.*, LXXXVI (June, 1960), 79-92.

17. See note 16.

18. "Markland," Public Affairs Office, Louisville District; Louisville District; Louisville District, *Information Bulletin*, August, 1972.

19. Bruce, Keller, and Neill, "Modern Facilities for Ohio River Navigation," paper No. 1239; Louisville District, *Information Bulletin*, November, 1972.

20. John W. Lane, "Lifeline to Mid-America," *Water Spectrum*, I (Summer, 1969), 17-18; Eugene Miller, Harry Thomas, and Herschel St. Ledger, "Unusual Design Features: Cannelton Locks and Dam" (manuscript of paper presented to ASCE, 1969, Engineering Division Office, Louisville District); Willard Roper to Frederick J. Clarke, July 2, 1970, in LDHF; Louisville *Courier-Journal*, July 27, September 5, 1972. The temporary lock at No. 52, Ohio River, was selected by the Chief of Engineers as one of the best designed projects in the nation in the year it was completed.

21. Willard Roper to William F. Cassidy, June 27, 1967, in LDHF; Louisville *Courier-Journal*, June 1, 1967; "A River Nightmare: Dam Jam," *Construction Digest*, June 22, 1967.

22. Louisville District, *Information Bulletin*, April, 1972; consult also Louisville newspapers for the period.

23. See note 22.

24. Louisville *Courier-Journal*, April 21-22, May 17, 1972.

25. *Ibid.*, July 12, July 19, 1972.

26. General Taylor is quoted in "Relation of the Ohio River and Its Tributaries to Transportation in the United States: A Symposium," *Transactions of American Society of Civil Engineers*, LXXXIX (1926), 1157.

27. The same general developments were true also on other Ohio River tributaries in upriver Engineer Districts, but not in all cases. The Monongahela river in Pittsburgh Engineer District was one of the exceptions.

28. ARCE, 1909, pp. 1879-81; James G. Warren to Chief of Engineers, September 8, 1909, in Kansas City Federal Records Center, Box NA1044, Folder Misc. 824, Nos. 2/3, NA, RG 77.

29. Dan C. Kingman to Secretary of War, August 11, 1915, in "General Correspondence, 1894-1923," NA, RG 77; G. R. Lukesh to Chief of Engineers, October 3, 1924, in OCE, "Civil Works, 1923-1942, Rivers and Harbors, NA, RG 77; Julian L. Schley to Secretary of War, March 30, 1938, in *ibid.*

30. Wabash River Improvement Association to President Theodore Roosevelt, December 5, 1903, in "General Correspondence, 1894-1923," NA, RG 77; Wabash River Improvement Association to Secretary of War, December 11, 1903, in *ibid.*

31. U. S., Congress, Senate, National Waterways Commission, *Final Report of the National Waterways Commission*, S. Doc. No. 469, 62 Cong., 2 Sess., 1912, pp. 13-16; U. S., Congress, House, *Wabash River, Ohio, Indiana and Illinois*, H. Doc. No. 100, 73 Cong., 1 Sess., 1934, p. 2.

32. W. A. Colston, *Statement and Brief on Behalf of the Chesapeake and Ohio Railway Company, Pere Marquette Railway Company, the New York, Chicago and St. Louis Railroad Company: Hearing before Lieut. Col. W. A. Johnson, Corps of Engineers, at Fort Wayne, Indiana, July 14, 1931* (pamphlet; Cleveland, 1931), *passim*; Paul Cribbins, "A Proposed Navigable Waterway for the Wabash and Maumee Rivers" (unpublished doctoral dissertation; Purdue University, 1959), *passim*; Willard Roper to William F. Cassidy, June 27, 1967, in LDHF.

33. *The Hoosier Waltonian*, Fall, 1968, p. 12; *Wabash Plain Dealer*, October 24, 1968; *Chicago American*, October 27, 1968; *Marion Chronicle Tribune*, October 14, 1968; *Fort Wayne Journal Gazette*, October 23 and 31, 1968; Henry J. Wallace to Louisville District, u. d., in LDHF.

34. John T. Rhett to Division Engineer, May 10, 1971, in Public Affairs Office, Louisville District.

35. ARCE, 1904, p. 2470; Louisville District to Chief of Engineers, October 3, 1913, inclosing "Preliminary Draft of Comprehensive Plan," in Kansas City Federal Records Center, Box NA1044, Folder 1943/19/Misc., NA, RG 77.

36. ARCE, 1932, p. 1308; ARCE, 1949, p. 836; J. H. Fenwick to the President, March 16, 1933, in OCE, "Civil Works, 1923-1942, Rivers and Harbors," NA, RG 77. The Louisville District operated a suboffice at Bowling Green from 1888-1901 which supervised the Green-Barren River project. From 1901 to 1927, the project was supervised (by Master Overseer W. S. Overstreet for many years) from an office at Woodbury (Lock No. 4), Kentucky; The Owensboro Substation directed operation of the project from 1927 to 1947. During the 1930s flashboards were installed atop Dam No. 5, and snags and boulders were cleared from Nolin River and Bear Creek to aid in the movement of rock asphalt.

37. ARCE, 1931, p. 1409; ARCE, 1949, p. 836; ARCE, 1951, p. 1504; ARCE, 1961, p. 1098. In 1970 a houseboat, the *Rose Howe*, navigated up the Rough River to Hartford, Kentucky, the first to accomplish the trip in 25 years; and in 1972 a coal company proposed construction of a barge-loading terminal at Livermore, Kentucky, near the mouth of the river.

38. ARCE, 1951, p. 1502; Louisville District, "Improvement of Green River for Navigation" (7 page report in Public Affairs Office, Louisville District); *passim*; U. S., Congress, House, Committee on Public Works, *Rivers and Harbors Omnibus Bill, Hearings on H. R. 9859*, 83 Cong., 2 Sess., 1954, pp. 453-72.

39. Louisville District, "Civil Works Activities; Corps of Engineers, Louisville District" (10 page report, 1960?, in LDHF), *passim*; ARCE, 1954, pp. 915-18; ARCE, 1955, pp. 872-73; Central City *Messenger*, April 13, 1961; ARCE, 1965, pp. 891-92; ARCE, 1966, p. 965.

40. Louisville District to Chief of Engineers, October 3, 1913, in Kansas City Federal Records Center, Box NA1044, Folder 1943/19/Misc.

41. ARCE, 1930, pp. 1392-93; ARCE, 1931, p. 1411; ARCE, 1949, p. 837; ARCE, 1958, pp. 982-83; Louisville District, "Civil Works Activities; Corps of Engineers, Louisville

District," *passim*.

42. L. H. Rand and W. W. Parker, "Preliminary Draft of Report on Comprehensive Plan for Improvement of Waterways Relating to the 2nd Cincinnati, O. District" (18 page report, dated 1913; in Kansas City Federal Records Center, Box NA1044, Folder 1943/17/Misc., NA, RG 77; ARCE, 1910, p. 1994).

43. ARCE, 1917, pp. 3017-21; ARCE, 1929, pp. 1294-95; ARCE, 1918, p. 3069; ARCE, 1919, p. 3122; Lucien S. Johnson to District Engineer, December 7, 1918, in "General Correspondence, 1894-1923," NA, RG 77.

44. Cincinnati District, *Histories of Navigation on the Ohio and Kentucky*, pp. 29-30; ARCE, 1949, p. 835; *S&D Reflector*, IV (March, 1967), 32; *ibid.*, V (March, 1968), 2; *ibid.*, V (June, 1968), 2.

45. ARCE, 1952, p. 1442; Robert G. West to Arthur W. Pence, July 9, 1951, in Ohio River Division Historical Files; Louisville District, "Civil Works Activities; Corps of Engineers, Louisville District," *passim*.

46. Several analyses of the subject have been attempted. Consult Joseph R. Cordaro, "The Economic Development of the Ohio River Valley Due to the Influence of Water Transportation" (unpublished master's thesis, University of Louisville, 1965); Alexander S. Chamberlain, *The Role of the Ohio River in the Development of Ohio Valley Industry*, *passim*; National Waterways Conference, Inc., "The Value of Low-Cost Water Transportation to the Louisville Economy" (5

page report; copy in Public Affairs Office, Louisville District).

47. See note 46 above and the testimony of Marvin J. Barloon, Professor of Economics, Western Reserve University, before a Senate Committee in 1960 printed in U. S., Congress, Senate, *Water Resources, Hearings Pursuant to S. Res. 48*, 86 Cong., 2 Sess., 1960, pp. 3076-88. Professor Barloon said: (p. 3085)

The availability of a wide variety of low-cost steels, of aluminum, of industrial chemicals, electric power, and other direct products of river transportation have made this an attractive location, even to those whose managements may not have recognized the role the river played in laying the foundation for their decision to build here. Even those new industrial establishments which do not use the river have been constructed in the Ohio Valley, to a large extent, as an indirect consequence of low-cost navigation.

48. National Waterways Conference, Inc., "The Value of Low-Cost Water Transportation to the Louisville Economy," *passim*; Cordaro, "The Economic Development of The Ohio River Valley Due to the Influence of Water Transportation," pp. 54-57. On December 8, 1972, the Louisville-Jefferson County Riverport Authority initiated a study of the economic impact of Ohio River commerce on the Louisville area.

49. Louisville *Courier-Journal*, November 30, 1971; John W. Lane, "Lifeline to Mid-America," *Water Spectrum*, 1 (Summer, 1969), 15-18.

CHAPTER XV: FOOTNOTES

1. *River Rises*, June, 1945, p. 6; *ibid.*, August, 1945, p. 12, summarized construction of these projects. For further details, consult the Louisville District section of the ARCE for 1937 through 1945.

2. ARCE, 1942, pp. 2, 5-6; ARCE, 1943, pp. 1106-13; U. S., Congress, House, Committee on Flood Control, *Flood-Control Plans and New Projects, Hearings on H. R. 4485*, 78 Cong., 1 Sess., 1943, pp. 61, 64.

3. ARCE, 1945, pp. 1511-27; U. S., Congress, House, Committee on Flood Control, *Emergency Flood-Control Work*, hearings on S. 938, 79 Cong., 1 Sess., 1945, pp. 6-9.

4. U. S., Congress, House, Committee on Flood Control, *Flood Control Bill of 1946, Hearings on H. R. 6597*, 79 Cong., 2 Sess., 1946, p. 203. O. Slack Barrett was president of OVIA at the time.

5. ARCE, 1946, pp. 2-3; "The Army Engineers' Program of Local Flood Protection" (5 page report, date 1965, in LDHF), *passim*; S. M. Bailey, R. E. Karlen, and Harry Pockras, "Local Flood Protection Projects, Ohio River Basin," *Journal of the Waterways and Harbors Division*, ASCE, LXXXVII (December, 1956), Paper No. 1128.

6. "The Army Engineers' Program of Local Flood Protection," *passim*; Louisville *Courier-Journal*, September 22, 1972.

7. ARCE, 1942, pp. 1195-96; Louisville District, *Project Maps and Data Sheets Covering Authorized Projects* (revised to 30 June 1970), FC 95. The latter source, which is regularly updated, provides maps, diagrams, photographs, and concise information about each project in the District; it is cited hereinafter as Louisville District, *Project Maps and Data*.

8. ARCE, 1947, pp. 1709-14; ARCE, 1948, p. 1899; Herbert C. Gee, "Flood Control: Public Works Investment Number 1" (4 page manuscript, n. d., in LDHF), *passim*.

9. ARCE, 1947, pp. 1705-07; Bailey, Karlen, and Pockras, "Local Flood Protection Projects, Ohio River Basin," *Journal of Waterways and Harbors Division*, ASCE, LXXXVII (December, 1956), Paper No. 1128.

10. Hazel Parker Haynes, "A Gift of a Floodwall," *Courier-Journal Magazine*, December 7, 1952.

11. ARCE, 1947, pp. 1619, 1673-76.

12. ARCE, 1940, p. 1405; Louisville District, *Survey Report for Flood Control: Wabash River and Tributaries, Indiana and Illinois* (4 vol. report, dated July, 1944, in Louisville District files), *passim*; ARCE, 1946, p. 1678; U. S., Congress, House, Committee on Flood Control, *Flood Control Bill of 1946, Hearings on H. R. 6597*, 79 Cong., 2 Sess., 1946, p. 268. The public hearing was held at Vincennes, Indiana, June 26, 1945. Samuel M. Bailey, Chief, Engineering Division, Louisville District, had been working closely with the Indiana Flood Control Commission prior to the hearing.

13. ARCE, 1946, p. 1678; ARCE, 1947, pp. 1741-43.

14. ARCE, 1947, pp. 1741-43; ARCE, 1950, pp. 1791-92; ARCE, 1953, pp. 1286-87; ARCE, 1955, pp. 895-96; Louisville District, *Information Bulletin*, October, 1971.

15. ARCE, 1955, pp. 892-93; Louisville District, *Project Maps and Data*, FC 133.

16. U. S., Congress, Senate, Committee on Public Works, *Rivers and Harbors - Flood Control, Hearings on H. R. 12080*, 84 Cong., 2 Sess., 1956, p. 36768; Louisville District, *Interim Report on Wabash River and Tributaries and above the Mouth of White River, Indiana for Flood Control and Allied Purposes* (pamphlet; Louisville District, 1955), *passim*; Louisville District, *Information Bulletin*, June, 1971, and July, 1971. See also pertinent volumes of ARCE and descriptions provided in Louisville District, *Project Maps and Data*. No attempt has been made herein to describe the extensive flood emergency operations of the District in the Wabash Basin, or assess the effect of repeated flood damages on public opinion along the Wabash. Suffice it to say that after the Wabash flood of 1950, in which the District saved the City of Vincennes, Indiana, by emergency work on the levees, Mayor William L. Betz wrote General Lewis A. Pick, Chief of Engineers, January 26, 1950 (copy in Ohio River Division Historical Files): "It is quite a coincidence that these same gentlemen rescued our people and city in 1943

and again so efficiently in 1950. Is it any wonder that we find it hard to express our thanks adequately?"

17. Consult descriptions of the projects named in the ARCE for 1966 through 1975, and Louisville District, *Project Maps and Data*. See also Wabash River Coordinating Committee, *Wabash River Basin Comprehensive Study* (14 volumes; Louisville District, 1971), I, *passim*.

18. U. S., Congress, Senate, Committee on Public Works, *Green River Watershed, Kentucky and Tennessee, Hearings on S. 2616*, 82 Cong., 2 Sess., 1952, pp. 16-20.

19. *Ibid.*, pp. 37-38, 60; Green River Valley Citizens League, Inc., *Flood Control - Water Storage - Green River Valley* (3 page pamphlet, dated 1956, in Manuscript Division, University of Kentucky, Lexington), *passim*.

20. Louisville District, "Improvement of the Green River for Navigation" (9 page report, 1955 (?), in Public Affairs Office, Louisville District), *passim*.

21. U. S., Congress, House, Committee on Flood Control, *Flood Control Bill of 1946, Hearings on H. R. 6597*, 79 Cong., 2 Sess., 1946, p. 220. The Barren County Superintendent of Schools who made this comment was Wilson Burks. See also U. S., Congress, House, *Barren River, Ky. and Tenn.*, H. Doc. No. 765, 78 Cong., 2 Sess., 1944, for further material revealing upstream opposition.

22. Louisville *Courier-Journal*, April 12, 1959. Details of construction of each project are furnished in ARCE for the appropriate period, and Louisville District, *Project Maps and Data*.

23. *Louisville Journal*, March 19, 1841; Louisville *Courier-Journal*, May 11, 1972.

24. ARCE, 1967, pp. 975-76; Louisville *Courier-Journal*, January 25, May 11, September 22, October 11, October 28, 1972.

25. Louisville *Courier-Journal*, November 28, December 6, 1971; *ibid.*, February 25, May 11, 1972. Mrs. Alma Stiles of Howardstown, cousin of George Stiles, a leader of opposition to the project, is quoted in Louisville *Courier-Journal*, November 28, 1971. Colonel John Rhett's comments on the 1967 hearings are printed in the same article, along with comments by Lt. Col. George Shields, Louisville Deputy District Engineer, and various proponents of the Howardstown project.

26. U. S., Congress, House, *Kentucky River and Tributaries, Kentucky*, H. Doc. No. 504, 78 Cong., 2 Sess., 1944, describes early Corps planning. One of the principal objections to the Jessamine Creek project was the submerging of the site of Boonesboro. Historian Thomas D. Clark in his history of the Kentucky River commented: "The argument simmers down to the cold and practical one of which shall be served, living Kentuckians in towns like Frankfort and Louisville and those along the river or a chapter in Kentucky history which is safely recorded in historical documents high above the water line." See Thomas D. Clark, *The Kentucky*, pp. 395-96.

27. Louisville *Courier-Journal*, July 19, 1972; Louisville District, "Public Hearing for Review of the Status of the Authorized Booneville Reservoir in the Kentucky River Basin" (Transcript of hearing at Irvine, Kentucky, January 4, 1963, in Public Affairs Office, Louisville District), provides pro and con arguments on the Booneville project. See also *Estill Herald*, January 10, 1963.

28. Louisville District, "History of Louisville District, Corps of Engineers," n. p.; U. S., Congress, Senate, Committee on Public Works, *Rivers and Harbors - Flood Control*, 1962, 87 Cong., 2 Sess., 1962, pp. 340-44.

29. *Morehead News*, December 5, 1968 (see also August 12, 1965, issue); Louisville *Courier-Journal*, August 25, 1972.

30. Louisville District, "Report of Ad Hoc Committee on Cave Run Emergency, Licking River, Kentucky" (unpublished report; Louisville District, 1971), *passim*; Louisville District, *Information Bulletin*, September, 1971.

31. See reports in Louisville *Courier-Journal*, April 20, May 10, May 15, July 1, August 25, September 22, September 24, October 11, October 28, 1972.

32. ARCE, 1947, pp. 1743-44; ARCE, 1956, pp. 1041-42; Douglas L. Weart and James W. Bruce, "Ohio River Basin Flood Control Plan," *Military Engineer*, XL (August, 1948), 348-49; U. S., Congress, House, Committee on Flood Control, *Flood Control Bill of 1946, Hearings on H. R. 6597*, 79 Cong., 2 Sess., 1946, pp. 280-93.

33. ARCE, 1963, p. 1005; ARCE, 1968, p. 728.

34. See Louisville District, *Project Maps and Data*, for detailed information concerning each project.

35. *Ibid.*; ARCE, 1949, pp. 1706-07; ARCE, 1963, pp. 1001-02; Louisville District, *Information Bulletin*, September, 1971.

36. ARCE, 1945, pp. 5-6; A. L. Parson, Jr., "Recreation Facilities at Locks and Dams," *Military Engineer*, XL (October, 1948), 463.

37. "Authorities, Policies and Procedures Governing Recreational Aspects of Corps of Engineers Water Resource Development Projects" (9 page report, 1963(?), in LDHF), *passim*; U. S., Congress, Senate, Committee on Public Works, *Evaluation of Recreational Benefits from Reservoirs, Hearings on S. 1164 and S. 1221*, 85 Cong., 1 Sess., 1957, p. 15.

38. U. S., Congress, Senate, *Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources* (Supplement No. 1, June 4, 1964), S. Doc. No. 97, 87 Cong., 2 Sess., 1962, *passim*; ARCE, 1966, p. 9; Clayne R. Jensen, *Outdoor Recreation in America: Trends, Problems, and Opportunities* (Minneapolis, 1970), p. 76.

39. W. P. Leber to William F. Cassidy, July 23, 1965, copy in LDHF.

40. McMurtire, *Sketches of Louisville and Its Environs*, p. 11; ARCE, 1887, p. 1856; see also ARCE, 1896, p. 2234.

41. U. S., Congress, House, *Ohio River Pollution Control*, H. Doc. No. 266, 78 Cong., 1 Sess., 1943, pp. 14, 36-37; E. S. Tisdale, "Progress in Pollution Control in the Ohio River Basin," *Transactions of American Society of Civil Engineers*, CIV (1939), 852-59. The history of ORSANCO is reviewed in Edward J. Cleary, *The ORSANCO Story, Water Quality Management in the Ohio Valley Under an Interstate Compact* (Baltimore, 1967).

42. Brent Spence to Harry Woodring, April 7, 1937, in OCE, "Civil Works, 1923-1942, Rivers and Harbors Files," NA, RG 77; Edward M. Markham to Brent Spence, April 23, 1937, in *ibid.*

43. J. W. Arras to H. C. Newcomer, July 19, 1911, in "Press Copies of Letters . . . to the Senior Member of the Board. Located at Pittsburgh, 1911-1912," NA, RG 77; W. P. Leber to William F. Cassidy, July 23, 1965, copy in LDHF. Description of the river as a "cesspool" was common before 1960, and the author can recall, as most Ohio Valley residents can, some very unsightly conditions along the river before that date.

44. U. S., Congress, House, *Ohio River Pollution Control*, H. Doc. No. 266, 78 Cong., 1 Sess., 1943, *passim*. Any study of the problem should be initiated with a review of this report, which also provides a bibliography of pertinent sources.

45. ARCE, 1966, p. 12; General William L. Starnes, ORD, address to Engineering Association of Nashville, September 13, 1971.

EPILOGUE: FOOTNOTES

1. William G. Berberet, "The Historical Framework of Environmental Politics" (Paper presented at Duquesne History Forum, Pittsburgh, October 29, 1971), reviews the connection between the early conservationists and modern environmentalists.

2. Louisville District, *Information Bulletin*, December, 1970; Greencastle *Daily Graphic*, July 26, 1969; "The Big Walnut," *Audubon Magazine*, September, 1969, p. 127; John T. Rhett to Director, Institute for Water Resources, n. d., in Public Affairs Office, Louisville District.

3. See note 2 above.

4. Louisville District, *Big Walnut Lake: Special Report on Alternatives* (pamphlet; Louisville District, 1972), *passim* (comments of Thomas Dustin in Exhibit 3).

5. Louisville District, *Information Bulletin*, May, 1972; "Engineers and the Environmental Movement," *Military Engineer*, LXIV (May-June, 1972), 175-76; "Engineer In-

terview: with Lieutenant General Frederick J. Clarke," *The Engineer*, I (Summer, 1971), 5.

6. See Wabash River Coordinating Committee, *Wabash River Basin Comprehensive Study* (14 volumes; Louisville District, 1971); and Ohio River Coordinating Committee, *Ohio River Basin Comprehensive Survey* (14 volumes; Cincinnati (ORD), 1969). Works which also may be consulted with profit are Wendell E. Johnson, "Water Resources Program Management," *Military Engineer*, LV (November-December, 1963), 391-92; Dewitt L. Pyburn, "Navigable Waterways and Industrial Development," *Journal of Waterways and Harbors Division*, ASCE, LXXXIII (May, 1957), Paper No. 1252; ARCE, 1951, Pt. 1 III, *passim*.

7. Corps of Engineers, Office of Appalachian Studies, *Development of Water Resources in Appalachia*, Vol. 1 (Cincinnati (ORD), 1969), p. xiii.

APPENDIX A

CHRONOLOGY OF COMMAND: LOUISVILLE ENGINEER DISTRICT, 1867-1973

An Engineer office, usually described as the "Office of Western River Improvements," was maintained by the Corps at Louisville on a near-continuous basis from 1824 to 1860, but the present Louisville Engineer District organization was actually established on May 11, 1867, when the Chief of Engineers ordered Major General Godfrey Weitzel to Louisville to supervise surveys of the Falls of the Ohio area. General Weitzel established a "District" office at the Louisville and Portland Canal and supervised the activities of this office until 1882. From 1882 to 1886, the Louisville Engineer Office was in charge of Colonel William E. Merrill, who served concurrently as Cincinnati District Engineer. In 1886 Major Amos Stickney was assigned full and sole responsibility for the activities of the Louisville Engineer District; and, because Major Stickney was in charge of the District in 1888 when the term "District" became the official designation of an Engineer officer's geographic area of responsibility, he was technically the first Louisville District Engineer. The official chronology of command (which omits some officers who served on a temporary, or acting, basis) is listed below:

Godfrey Weitzel, MG (BVT.)	1867-1882	James G. Warren, CPT	1894-1898
William E. Merrill, COL	1882-1886	George A. Zinn, CPT	1898-1900
Amos Stickney, MAJ	1886-1890	William L. Sibert, CPT	1900-1901
Edward Maguire, CPT	1890-1891	E. H. Ruffner, MAJ	1901-1902
Garrett G. Lydecker, COL	1891-1893	George McC. Derby, MAJ	1902-1903
Hiram M. Chittenden, LT	1893-1893	Harry Burgess, CPT	1903-1908
Thomas H. Handbury, MAJ	1893-1894	Lytle Brown, MAJ	1908-1912
		Henry Jervey, LTC	1912-1912
		John C. Oakes, MAJ	1912-1916
		George R. Spalding, MAJ	1916-1917
		William P. Stokey, COL	1917-1918
		William H. McAlpine, ASST ENGR	1918-1919
		George M Hoffman, COL	1919-1920
		G. R. Lukesh, LTC	1920-1925
		George R. Spalding, LTC	1925-1929
		Roger G. Powell, LTC	1929-1930
		William A. Johnson, LTC	1930-1933
		Gilbert Van B. Wilkes, LTC	1933-1936
		D. O. Elliott, LTC	1936-1937
		D. A. Davison, LTC	1937-1939
		Lester F. Rhodes, MAJ	1939-1940
		Henry H. Hutchings, Jr., LTC	1940-1942
		Henry H. Hannis, COL	1942-1943
		Jesse H. Veal, LTC	1943-1944
		Gilbert Van B. Wilkes, COL	1944-1946
		B. B. Talley, COL	1946-1948
		John L. Person, COL	1948-1950
		Clarence Bidgood, LTC	1950-1953
		William D. Milne, COL	1953-1956
		Edward D. Comm, COL	1956-1958
		C. C. Noble, COL	1958-1960
		James L. Lewis, Col	1960-1963
		Willard Roper, COL	1963-1966
		Robert R. Wessels, COL	1966-1969
		John T. Rhett, Jr., COL	1969-1972
		Charles J. Fiala, COL	1972-1975
		James N. Ellis, COL	1975-

APPENDIX B

CHRONOLOGY OF COMMAND: CINCINNATI ENGINEER DISTRICT, 1871-1946

William Milnor Roberts, U. S. Civil Engineer, established the Office of Ohio River Improvement at Pittsburgh, Pennsylvania, in 1866. Colonel William E. Merrill, Corps of Engineer, took command of the Office of Ohio River Improvement on June 17, 1870; and on June 1, 1871, this office was transferred to Cincinnati, Ohio, where Colonel Merrill served as Cincinnati District Engineer until 1891. The Office of Ohio River Improvement, responsible for the open-channel project for navigation improvement on the Ohio, became commonly known as the First Cincinnati District to distinguish from the Second Cincinnati District, which had charge of projects for the improvement of streams tributary to the Ohio. The Second Cincinnati District was amalgamated with the First Cincinnati District and Huntington Engineer District in 1922. Effective January 1, 1947, the functions and geographic area of responsibility of the First Cincinnati District was reassigned to Huntington and Louisville Engineer Districts. The official chronology of command (which omits some officers who served on a temporary, or acting, basis) for the First Cincinnati District is listed below;

William E. Merrill, COL 1871-1891

Daniel W. Lockwood, MAJ	1891-1892
Amos Stickney, MAJ	1892-1896
W. H. Heuer, MAJ	1896-1897
William H. Bixby, MAJ	1897-1902
Garrett J. Lydecker, COL	1902-1904
E. H. Ruffner, COL	1904-1906
James G. Warren, MAJ	1906-1906
William T. Rossell, COL	1906-1909
James G. Warren, MAJ	1909-1910
John C. Oakes, MAJ	1910-1910
Henry Jervey, COL	1910-1915
George R. Spalding, MAJ	1915-1916
Robert R. Ralston, MAJ	1916-1917
Lansing H. Beach, COL	1917-1917
Robert R. Jones, ASST ENGR	1917-1919
Earl I. Brown, COL	1919-1921
E. N. Johnston, LTC	1921-1923
A. K. B. Lyman, MAJ	1923-1926
Roger G. Powell, LTC	1926-1931
James D. Cleary, CPT	1931-1932
Charles L. Hall, LTC	1932-1936
D. O. Elliott, LTC	1936-1939
Fred T. Bass, MAJ	1939-1942
B. F. Vandervoort, COL	1942-1942
Joseph E. Gill, LTC	1942-1942
Jesse H. Veal, LTC	1942-1943
Ralph J. Griffin, LTC	1943-1944
F. A. Muhlenberg, LTC	1944-1945
Paschal N. Strong, COL	1945-1946
George N. Kibler, LTC	1946-1946
A. M. Neilson, COL	1946-1946

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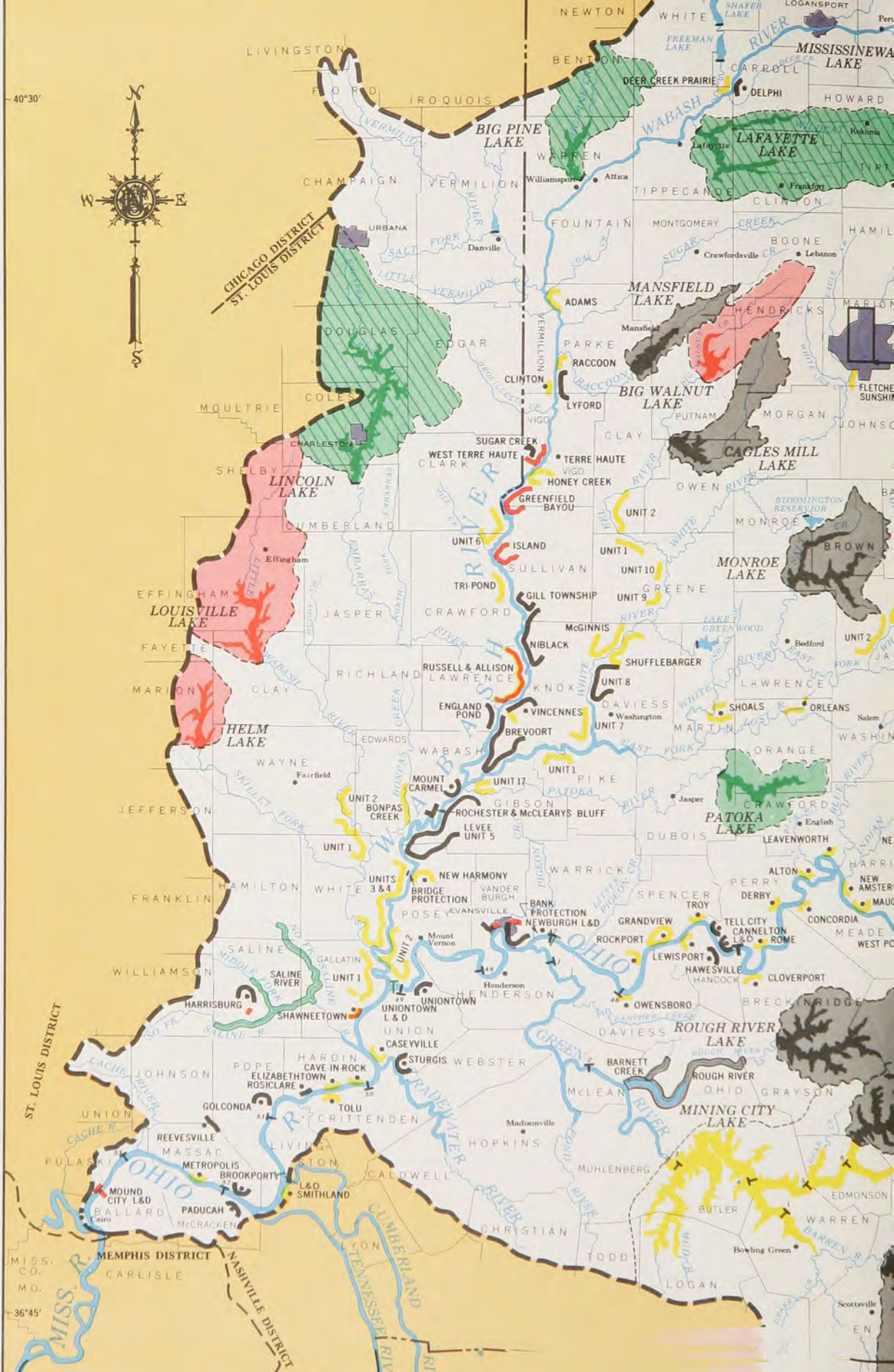
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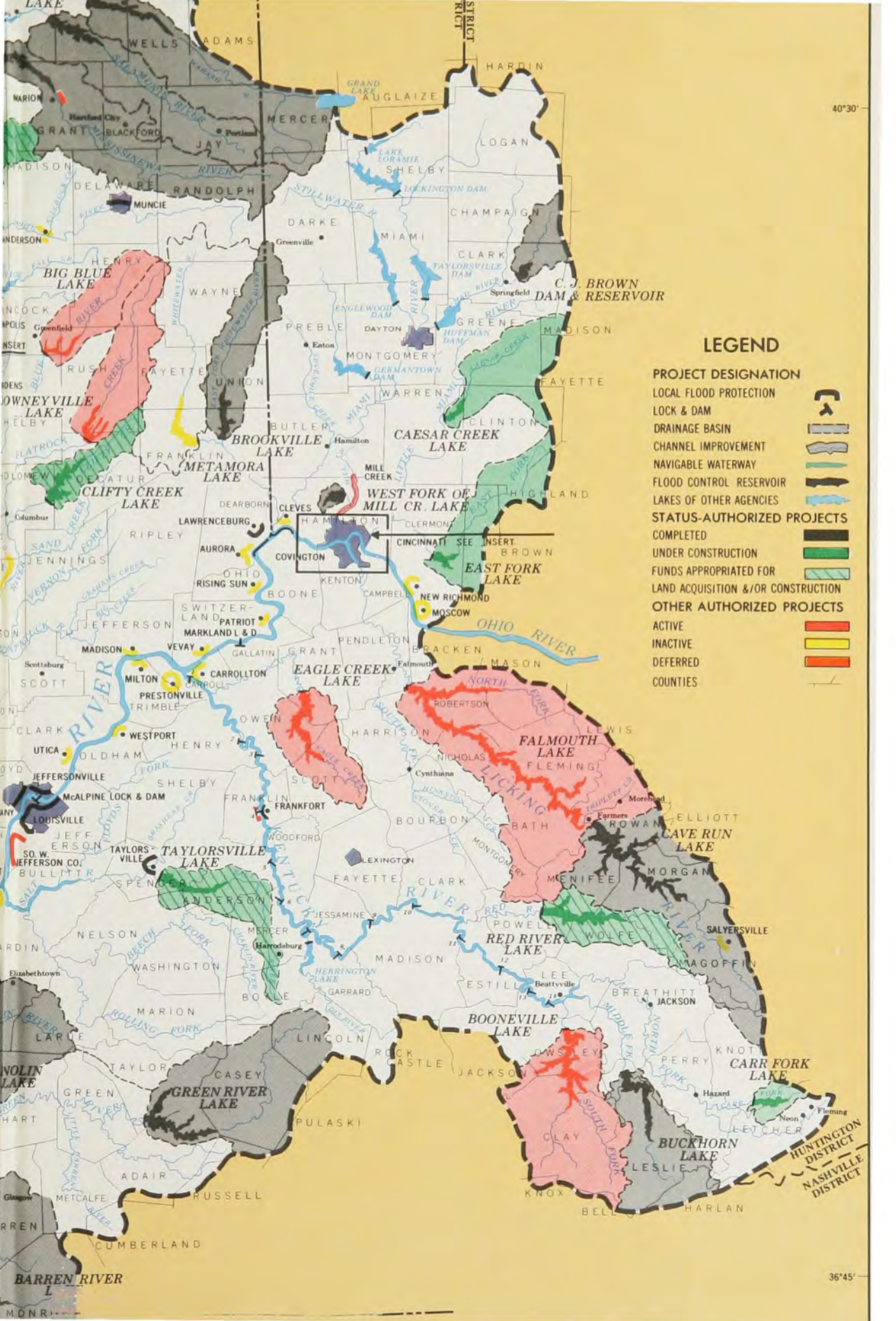
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40°30'





40°30'

36°45'

